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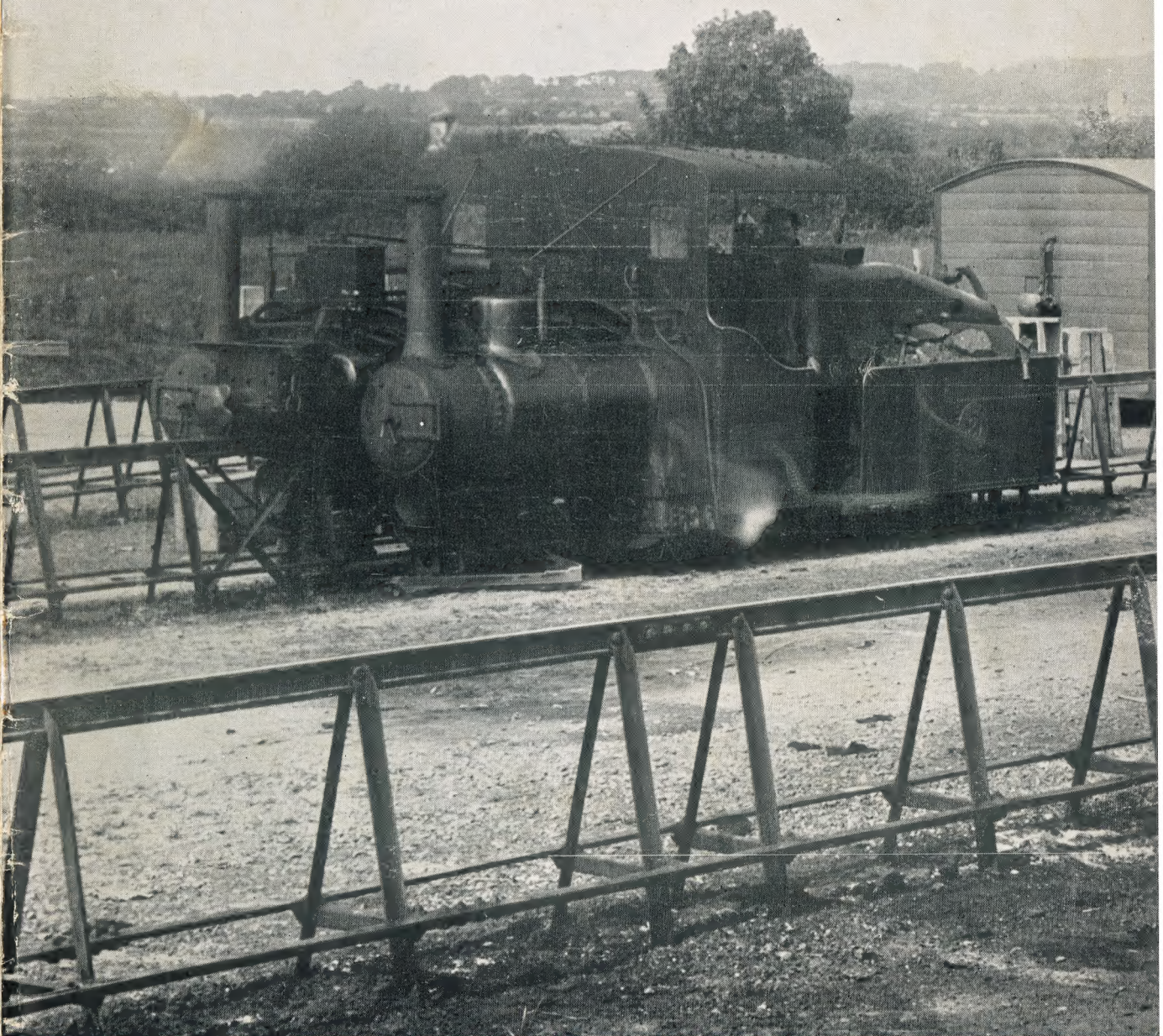

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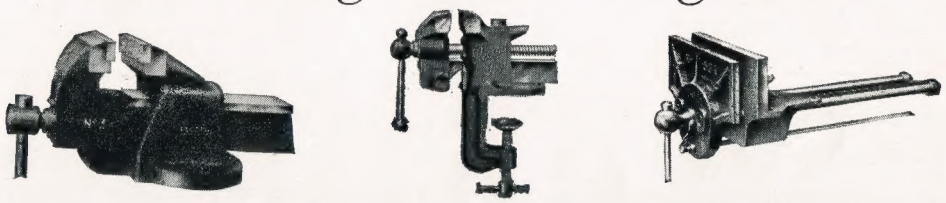

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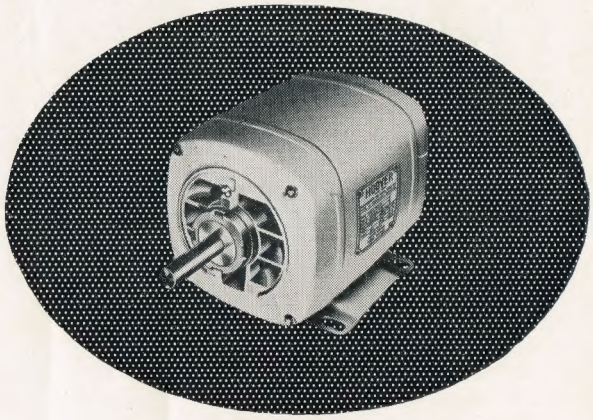

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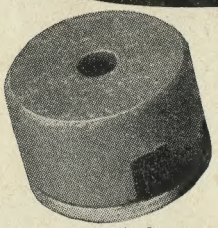

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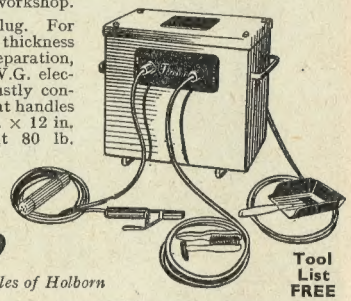

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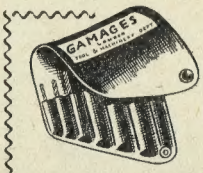

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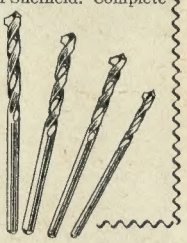

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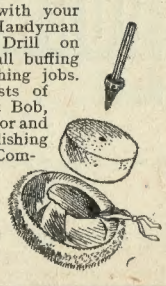

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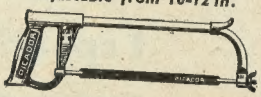

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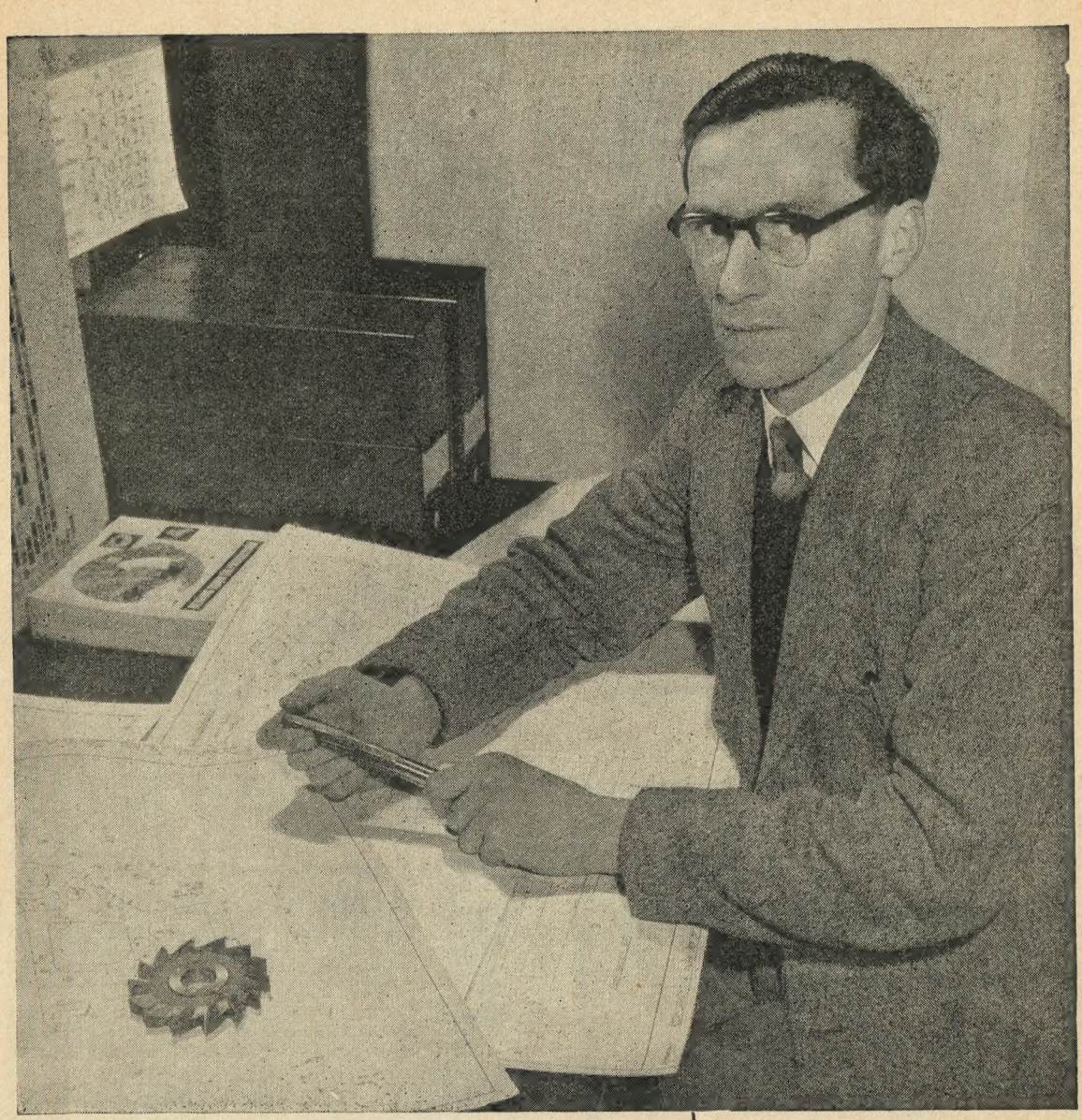

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Improvisation

All correspondence should be addressed to the Editor, Model Engineer, 19-20 Noel Street, London, W.1.

SMOKE RINGS

A WEEKLY COMMENTARY BY VULCAN

EXPERTS TELL US that the static electricity built up in cars is caused by the friction of the tyres against the road surface.

In order to disperse it, car owners troubled by this phenomenon fit a short chain to a metallic part of the car—the rear bumper and rear axle are favourite spots—so that the charge is shorted to earth as it builds up.

But these two facts do not seem to tie up. If the electricity is created by the tyres rubbing against the road how does the charge reach the body of the car through the insulating properties of the tyres? If one assumes that it does, by some mysterious means, achieve this object then what equally mysterious process prevents its returning to the road by the same path?

Shocking business

I have myself been troubled with this high-voltage discharge from my car, the shock being comparable to that from a sparking plug lead. Have readers met with the same effect, and if so have they any views on the subject?

Incidentally, I understand, in the U.S.A. petrol tankers must, by law, be fitted with earthing chains.

Ship problem

HERE is a little problem set by a reader. If a model boat, capable of five knots, is facing a current of five knots, what will happen? Will the boat move forward, remain stationary or drift backwards?

The reader says it will drift backwards because the propeller is pushing against something which it is trying to move away from. I am reserving my opinion at the moment, but what do you think?

Relative speeds

Similar trick problems often arise and the arguments they cause sometimes become quite alarming. I suppose everyone has heard of the old one about a man in an aircraft flying at 200 m.p.h. who fires a revolver behind him. The bullet has a muzzle velocity of 200 m.p.h. and as it is travelling in the opposite direction, it just stays in the barrel (or does it?).

Well, I do not want to start that hare again but during the last war a fighter pilot offered the semi-serious theory that the speed of aircraft would soon become faster than the muzzle velocity of the guns, so the shells would never leave the breech!

Fastest on rails

ONE THOUSAND five hundred miles an hour on rails! This is the phenomenal speed which a rocket sled has attained on the high-speed track at the United States' Edwards Air Force Base, California.

The sled, built by the Convair Division of General Dynamics Corporation, is designed to test the effect of rain erosion on aircraft or missiles travelling at supersonic speeds. Rain-

SMOKE RINGS . . .

storm conditions are simulated by jets of water which spurt from sprays spaced at regular intervals along 1,200 ft. of the 10,000 ft. track.

The sled is kept on the rails by slippers and the wear on the inserts is so excessive that they need replacement after four runs. Temperatures set up by the friction of the slippers reach 1,500 deg. F.

Stopping this phenomenal speedster was more of a problem than starting it. Eventually it was solved by a water brake, a scoop channelling water out of a 2,000 ft. trough between the rails.

How fast is 1,500 m.p.h. ? It reduces the four-minute television run to Brighton to a crawl. The sled could reach the famous South Coast resort in half that time.

Part of the service

LAST summer, at the instigation of Edgar T. Westbury, I printed a paragraph asking model engineers to search their junk boxes for a discarded steam engine which could be sent to a crippled model engineer.

I have now had a reply from R. H. Mapplebeck, of St. Alban's, at whose request Mr. Westbury first set the machinery in action. Mr. Mapplebeck tells me that a Mr. Chester Osborne, of Rahway, New Jersey, U.S.A., was able to provide such an engine.

Negotiations took a long time but eventually the person on whose behalf Mr. Mapplebeck made the appeal, an ex-Naval officer, received the engine and he was delighted with it.

Machine tool progress

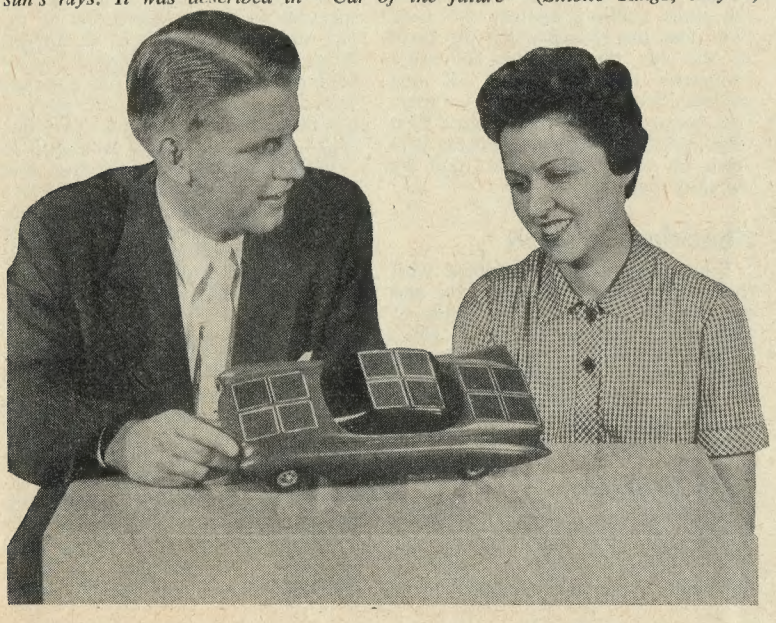
DISCUSSIONS on the subject of automation often fail to take into consideration the fact that its success depends primarily on the development of suitable machine tools to take full advantage of automatic control. But the recent Machine Tool Exhibition provided adequate proof that the people responsible for the design of these machines are fully alive to this aspect of the problem and some truly remarkable improvements in the machines themselves, no less than their control systems, were in evidence.

To mention but one or two examples: an immense horizontal boring machine was seen positioning holes in a large casting, to an accuracy of within one ten-thous. (0.0001 in.) to " orders " issued by a perforated card in an electronic control system. A milling machine carried out a series of complicated operations under the control of a magnetic tape comparable to that of the popular sound recorder.

Even more impressive was the performance of a small and relatively simple die-sinking machine, not much larger than the machines used in home workshops, which automatically engraved its own name in letters ¼ in. deep at one cut and another on the same stand which copied dies accurately in three dimensions from a pattern without the help of an operator.

Perhaps I should mention that the designer of the latter machines was a keen model engineer . . . !

The model car made by General Motors Corporation which is powered by the sun's rays. It was described in " Car of the future " (Smoke Rings, July 5)



Tooty . . .

WROTE the man who lived hard by the yard:

Why is it that your switch engine has to ding and dong and fizz and spit and bang and hiss and pant and grate and grind and puff and bump and chug and hoot and whistle and toot and wheeze and jar and jerk and howl and snarl and growl and boom and crash and jolt and screech and snort and slam and throb and roar and rattle and yell like h—— all night long ?

. . . fruity

THE agent replied in haughty tones:

Sorry, but if you are to get vital needs including meats and sweets and bread and spreads and guns and buns and beans and jeans and shorts and skirts and cakes and rakes and socks and locks and dippers and slippers and lotions and notions and hooks and eyes and cherry pies and candy bars and nuts in jars and sugar and spice and everything nice to make you happy all your life—you shouldn't criticise the noise of the railroad.

The *Canadian National Magazine* " pinched " these paragraphs from *Bruce West*; we take them from *Canadian National Magazine*.

Cover picture

One of the curious " double " locomotives, No. 3, which formerly worked on the Listowel and Ballybunnion Railway. The track and all the rolling stock were built in accordance with the Lartigue system of so-called monorail railways, and the L. and B.R. was probably the best-known example. Ernest F. Carter writes on the monorail on page 83. (Picture by courtesy Locomotive Publishing Co.)

The development of the

MONORAIL

This second article in the series by ERNEST F. CARTER deals with the Listowel and Ballybunion Railway, and the Behr Monorail

ENCOURAGED BY THE SUCCESS of the 60 miles of horse-operated line built on his raised monorail system in Tunisia and Algeria, by the monorail which ran at the Rouen Agricultural Exhibition in 1883, and by his electrically-propelled freight railway near Paris the following year, C. F. M. T. Lartigue collaborated with locomotive designer M. Mallet in the design of the steam-operated monorail which was demonstrated in 1886 on the site of old Westminster Prison—then known as Tothill Fields, Victoria Street, London.

Other Lartigue monorail lines were also in operation at the Ria Mines, up in the Pyrenees, at Oust-Sjord, St. Petersburg (now Leningrad), in Peru and Guatemala. A 12-mile line was also in operation on the Feurs-Pannisères branch of the Paris, Lyons and Mediterranean Railway.

With all this experience behind him, M. Lartigue embarked upon the construction of the 9½-mile Listowel and Ballybunion Railway at the mouth of the River Shannon in Ireland, for the construction of which, on the monorail system, an Act of Parliament was passed on 16 April 1886. It was the first public passenger-carrying monorail to be worked by steam and though it passed through very difficult boggy terrain the line was completed in less than five months from the date the land was secured—a complicated legal task which took over 17 months. Work was commenced in August 1887 and the line publicly opened on March 1 the following year.

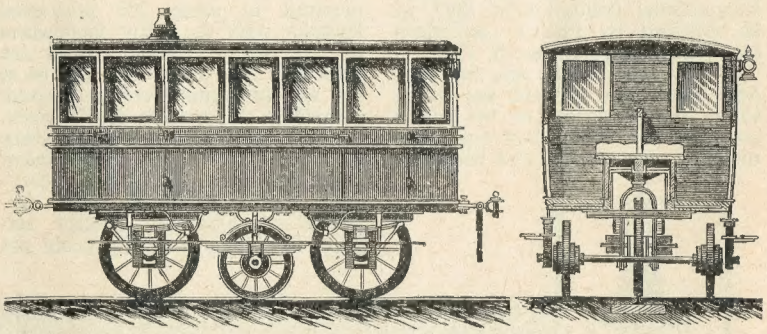
The line consisted of a single 27 lb. per yard rail bolted to the apex of A-shaped trestles made from 1¾ in. × 1¾ in. angle-iron, the rail surface being 3 ft. 3 in. above ground level. At a distance of 2 ft. below the running-rail was fixed a crossbar, and at each end of this was mounted a guide-rail to curb any tendency on the part of the vehicles towards lateral oscillation. The legs of the trestles, which were set along the line at 39 in. centres, rested on dished steel sleepers 3 ft. 3 in. × 6 in. × ¼ in. Each trestle weighed 12½ lb., and the complete track 70 tons per mile.

Turntables of very peculiar design did duty as switches, being ingeniously planned so as to get up to four through roads, by mounting the curved sections of track on the table off centre. If the rails over the turntables had been straight only one through road could have been obtained, and in order to pass from one line to another each vehicle of a train would have to have been uncoupled and treated separately; but by off-centring and curving the track across the tables through running and switching from road to road was possible.

As to locomotive power, there were three engines of what might be called 0-3-0 tender type, built by the Hunslet Engine Co., each weighing 10¾ tons in working order—of which the tenders each weighed 4¼ tons. Each engine had two distinct boilers, fireboxes and chimneys, the boilers being fitted with both steam and water equalising connections.

The tender, also, was divided longitudinally with two coal bunkers and tanks, and in the space immediately over the central running rail was fitted an auxiliary two-cylinder engine which could be brought into operation as and when required to boost the main engines. With three coupled 2 ft. dia. driving wheels an average speed of 25 m.p.h. with a top speed of 30 m.p.h. could be attained.

On the level 240 tons could be hauled with ease, which was reduced to 186 tons up 1 in 500, and 40 tons up 1 in 45—the steepest grade on the line. Four broad horizontal guide wheels were fitted—two on each side—to each vehicle at a point about 9 in. from its lower edge so as to engage with the two guide-rails on the trestles already mentioned.



Larmanjet Railway coach. (*Raincy-Montfermeil, Paris,* 1868)

Coaching stock consisted of three first- and four third-class vehicles carried upon two two-wheeled bogies fitted with 19 in. dia. wheels, and seating 20 and 24 passengers respectively. They were, like the two covered goods vans, two guard's vans, and one horse-box, 16 ft. long over headstocks, 7 ft. high, and 8 ft. 6 in. wide; though, while the coaches were roofed in two sections—one on either side of the running rail—the guard's vans were roofed right over and carried attached third class coupés and were fitted with steps by which the line could be crossed if desired.

There were also two 4-ton open wagons, two cattle trucks with convertible floors to carry pigs and sheep, and two queer " platform carriages "

which were included in each passenger train by which persons could easily cross the line. Twenty, 4-ton sand wagons 7 ft. long by 6 ft. 6 in. wide, built by Achille, Legrand, of Mons, Belgium, completed the rolling stock. All the coaching stock was built by the Falcon Engineering and Carriage Works, of Loughborough; and all wearing parts were completely interchangeable.

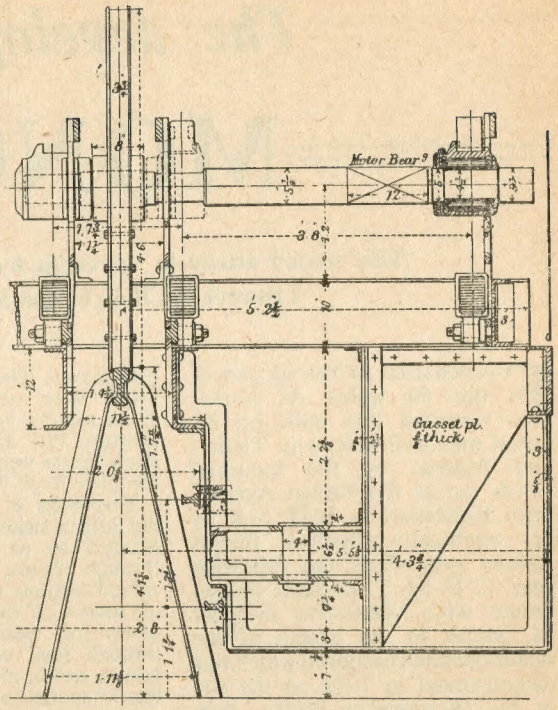
However, after about 11 years of life the Listowel and Ballybunion Railway passed into the Official Receiver's hands in 1897, but it continued to run until it was closed on 14 October 1924; after which date everything was dismantled and sold for scrap.

F. B. Behr's association with the Listowel and Ballybunion Railway as the managing director of the Lartigue Monorail Railway, inspired him to modify the basic system to electric traction by which far higher speeds could safely be attained and the first results of his intensive experimental work were eventually put before the public at the Brussels International Exhibition of 1897, to be followed by further oscillation-restraining improvements in 1903.

Modest man that he was, however, Behr never put forward any claim to be the originator of the raised monorail idea, and it was only after spending over £40,000 and becoming involved in some 200 protracted lawsuits with the petty landowners of the ground through which the exhibition line was to run that he at last saw his demonstration monorail completed and the car on the track.

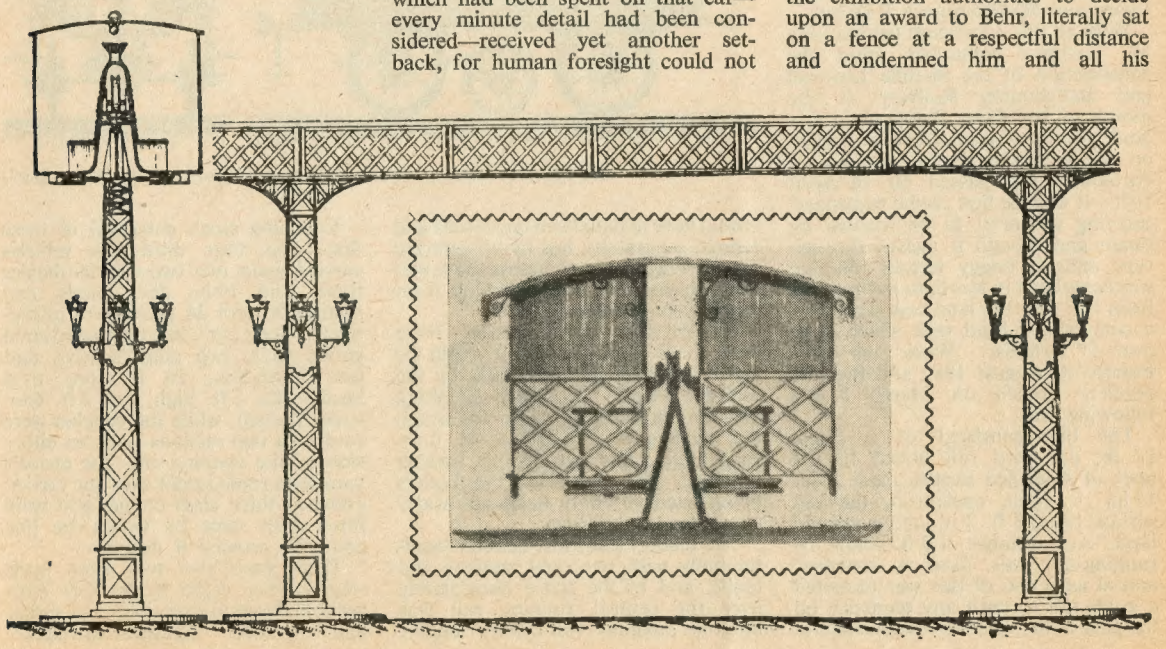
But his troubles were by no means at an end. The profusion of talent which had been spent on that car—every minute detail had been considered—received yet another set-back, for human foresight could not provide against the exigency of a newly-built power-station which could not supply electricity for the line until many weeks after the track and car were ready !

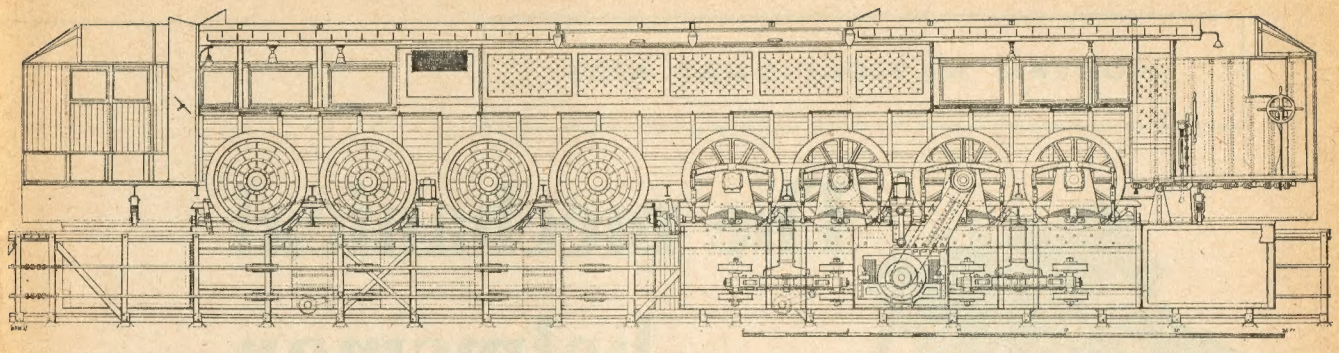
Behr could only fume over the protracted delay. Then on 14 July 1897, an eminent jury, appointed by the exhibition authorities to decide upon an award to Behr, literally sat on a fence at a respectful distance and condemned him and all his



Right: Front elevation showing constructional details of one side of the car

Below: Elevated and surface monorail as used at the Tothill Fields, Westminster. Inset: The type of car used on that line





Side elevation of Behr's monorail car as run at the Turverun track

works while the luxuriously-equipped car, currentless and stationary, stood forlornly at the far end of the siding track. The current supply had failed at the crucial moment !

At last, however, power was available, and after remarkably few teething troubles the car acquitted itself beyond all question by achieving the remarkable speed of 91 m.p.h., earning instantly for itself the sobriquet " Lightning Express " and becoming the " star turn " of the exhibition.

The track, which was located at Turverun, some few miles from the exhibition grounds, consisted of a flat-sided ellipse three miles in circuit with 1,800-yard radius curves at each end; around which a raised permanent way evolved from the primitive Lartigue system, was built. A-shaped trestles, 4 ft. 1½ in. high at 39 in. intervals—as on the Listowel and Ballybunion Railway—supported an 82 lb. per yard running rail with two lighter section guide rails at each side; a conductor rail being mounted on the sleepers.

The car itself, lavishly furnished in true nineteenth century Pullman style, was built by the Gloucester Carriage and Wagon Co., and was 58 ft. in length and 11 ft. wide; the body being suspended from two 4-wheeled bogies with 4 ft. 6 in. dia. wheels, of which two wheels in each bogie were individually driven through Renold silent chain 1 to 1 gearing by a four-pole 700 volt d.c. motor built by Parkinson of Wolverhampton and rated at 150 h.p. at 600 r.p.m.

Powered thus, by a total of 600 h.p., the 55-ton 100-seater Behr car, running as it did completely on ball-bearings, easily achieved very high speeds. It was effectively braked by Behr's patent air brakes, which consisted of rows of vertically pivoted louvres fore and aft, which could be opened at will through a worm-gear by the driver to destroy the effect of the car's end streamlining; thus reducing the speed without jerking before the application of the orthodox wheel brakes. The car seated 100 passengers on seats ranged longitudinally over the 16 guide wheels and driving mechanism.

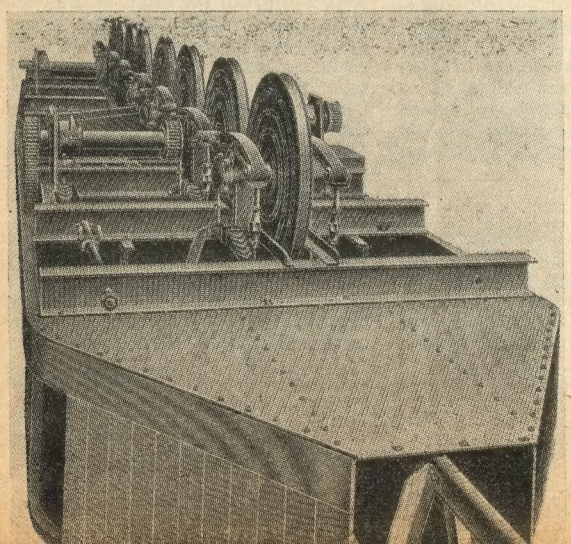
The improvements introduced in Behr's patent of 1903 were concerned with enabling the car to tilt when rounding a curve or when weight was unevenly distributed, thus greatly reducing the side thrusts on the guide wheels and consequently the losses due to friction.

The non-stop Liverpool Electric Express Railway from Liverpool to Manchester which, after exhaustive inquiries and criticism, received the Royal Assent on 17 August 1901, never materialised. It was to have been routed from the Bluecoat Hospital Liverpool, *via* Toxteth, Garston, Halewood, Widnes, Warrington, Eccles, Pendleton, and Salford, to a terminus on the west side of Deansgate Manchester. Three-phase current at 15,000 volts was to have been used, drawn from a generating station at Sankey and served through five sub-stations as continuous current at 650 volts to four 160 h.p. motors on each car. The cost was estimated at £2,800,000.

But though so eminently successful and cheap to build and operate, the Behr monorail system was heard very little of in this country, nor did it " catch on " as a desirable alternative to the conventional two-rail railway; and so today, the name of Behr is forgotten and his epic struggle to popularise a new form of transport is—just history.

● *To be concluded*

No, it's not the wrong way up. It is a view of Behr's car showing bogies and driving gear

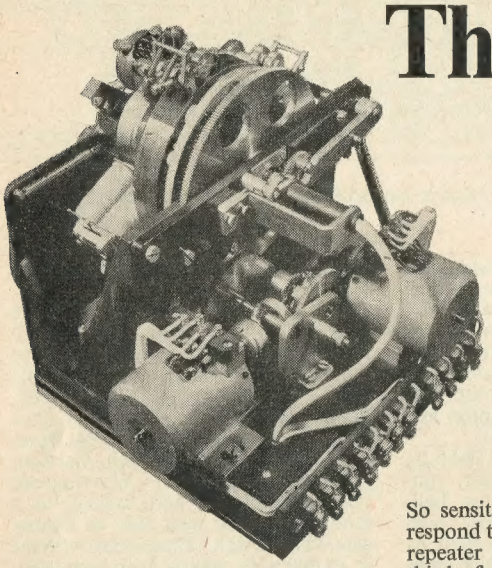


The lavish 19th century " Pullman " interior of Behr's " Lightning Express " coach

The mechanical helmsman

By A. Cecil Hampshire

Iron Mike, the robot, can check the "wandering" of a vessel far more accurately than any human . . .



Brown Automatic Helmsman brain unit, showing, left, contact drum and trolley with electro magnets and, right, the repeater and feed-back motors

AUTOMATION IS NO new thing afloat, having first appeared at sea some 30 years ago in the form of a robot helmsman. Today *Iron Mike*, as the robot is dubbed, has become almost as important a navigational aid as the gyro compass with which it works in concert.

For in these days of international competition and high marine operating costs the merchant ship, whether passenger or cargo carrier, must voyage about her business by the most direct line of route and with no avoidable loss of time. The cost of keeping one of the Queen liners at sea, for example, is well over £1,000 an hour. Thus a wavering wake means a loss of fuel, time and money to the shipowner.

But not even the most experienced human helmsman can steer his ship with accuracy and precision for long periods at a stretch and under varying weather conditions. And this is where *Iron Mike* comes in, for this robot helmsman can check the normal wandering of a vessel from side to side of her set course with more rhythmic precision than can be attained by its human counterpart. So sensitive is this device that it can respond to a movement of the compass repeater amounting to less than one-third of a degree—a feat beyond the capability of the average human helmsman.

The notion of automatic steering was born soon after the end of the first world war when the gyro compass was being adopted on an increasing scale by the merchant fleets of the world. Newer ships were then being equipped with the hydraulic telemotor system, which transmits the movements of the steering wheel to the valve of the steering engine driving the rudder stock.

By the early 1920s means had been devised by which the heading reference of the gyro compass could be similarly translated by remote control into helm corrections without human time lag.

Today the two principal British makes of *Iron Mike* are the Sperry Gyropilot and the Brown Automatic Helmsman. The latter firm manufactures four different types of robot to cover all general forms of ship steering gears. But each type functions by means of an identical "brains unit," somewhat prosaically referred to by the makers as the directional control element.

The helmsman

When automatic steering is in operation the brain is activated by the movement of the gryo compass repeater caused by the ship wandering off course. When this happens the helmsman, like the human quartermaster, immediately applies opposite helm to bring the ship back again. Having done so, the robot promptly checks the corrective swing of the vessel which, if not so restrained, would continue the cycle and result in a series of zig-zags.

This automaton works by means of a rotating contact drum driven by a small motor powered by the master gyro compass and a pair of breaker switches which alternately complete an electrical circuit between the brain and the after power unit; this ancillary piece of equipment links with the ship's steering system in vessels fitted with a hydraulic telemotor and other mechanical steering gears.

According to the appropriate movement of the contact drum, clockwise or anti-clockwise, port or starboard, corrective helm is applied. A special electrical device in the train of gearing of the after power unit transmits feed-back control to the brain to limit the swing of the rudder. No after power unit is needed for ships fitted with all-electric steering, for the particular type of automatic helmsman manufactured for such ships—a bulkhead instead of a pedestal model—couples directly in to the ship's gear exciter unit. In this model, feed-back control is exercised through a rudder feed-back transmitter.

Mounted on a chassis made from a casting of light strong alloy, specially heat treated and anodised to resist corrosion, the brain of the automatic helmsman is in two sections separated by a bridge piece. One section com-

prises two small 50-volt motors which, when activated, operate a train of differential gearing to which both are connected. The function of the first of these, known as the repeater motor, is to receive and act on the movements of the compass repeater which indicates that the ship is wandering off course. The second, linked with the after power unit which transmits the appropriate helm signals to the ship's steering system, operates as the feed back—reversing the drum movement and limiting the rudder swing.

Meshed into the teeth of the differential gearing and driven by both repeater and feed-back motors, is a larger brass gear wheel which forms one part of the rotating drum. This contact drum is a precision-built assembly, comprising two copper conducting strips on either side of a wide insulated sector and separated from it by slender segments of tungum metal and mica. To ensure absolute accuracy the surface of the drum is diamond turned after assembly to a finish tolerance of $\frac{1}{2}$/1000 in. The drum is mounted on high precision ball races to give ease of movement.

In the other section of the chassis and attached to the drum axis, but independently mounted on a bronze spindle, is a Y-shaped bracket or trolley of nickel-plated brass, weighted at its base and carefully balanced so that it is free to rotate within a limited arc. The arms of the Y overhang the contact drum and carry a pair of small tungum metal rollers which rest on its curved surface, spring loaded to ensure even pressure as they revolve over the drum.

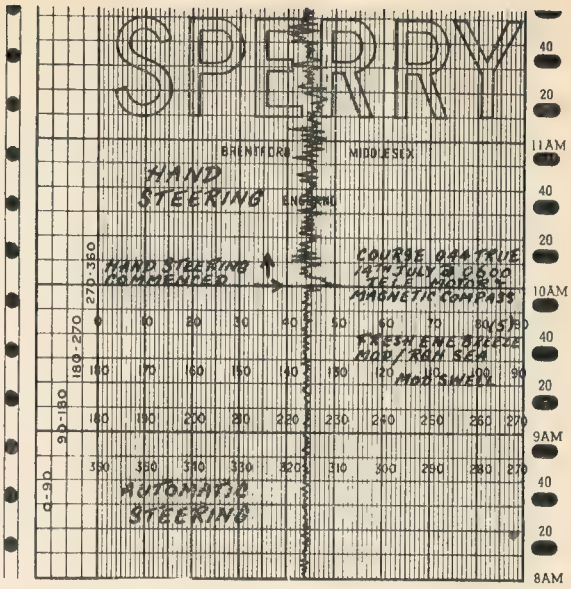
Since the purpose of these rollers is to complete the electrical circuit over which power to alter the helm is periodically transmitted to the after power unit, perfect conductivity is ensured by sharply grooving their edges to cut through any deposit of dirt or other foreign element which might accumulate on the surface of the drum.

Not all movements of the compass repeater require helm adjustment, however. For it is obvious that when a ship is rolling while pitching, or pitching while listing, the ship's head will wander from side to side of the mean course due to this motion. Although these movements will appear on the repeater they need not be continually corrected by rudder application. This natural " yaw " of a ship in heavy weather is allowed for by the introduction of a device known as the contact roller adjustment.

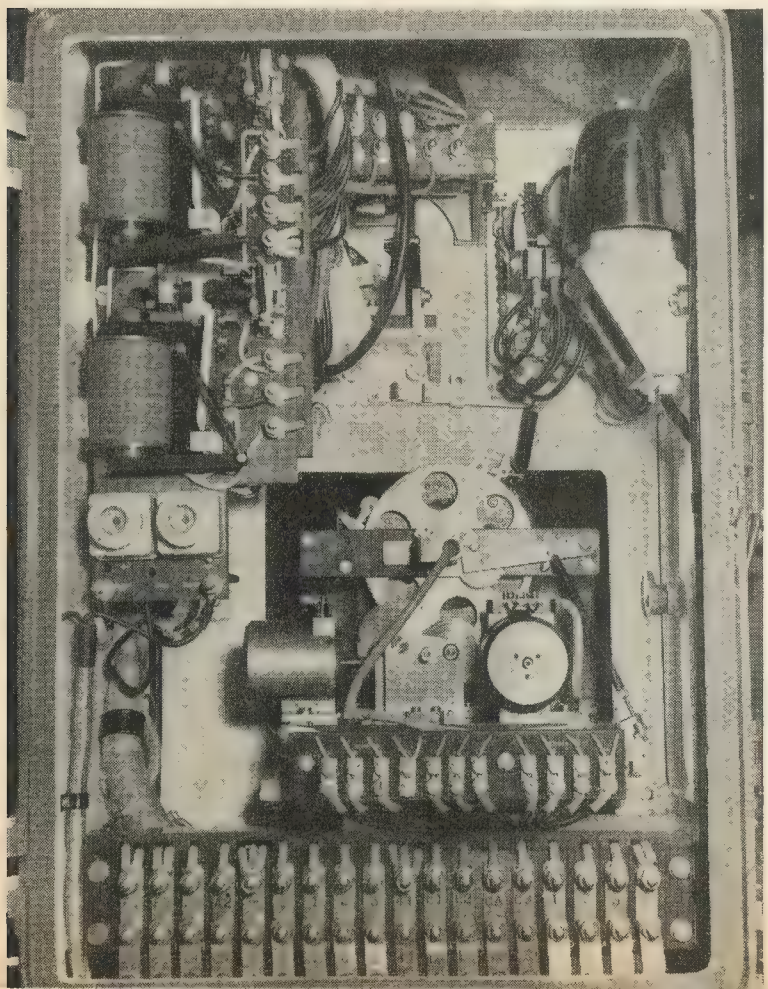
By means of an adjustable screw beneath a graduated dial the distance apart of the two sets of rollers can be increased or decreased—so that in span they almost cover the insulated strip between the drum contacts or are brought closer together, the extent of the gap being shown as a measurement on the dial.

To keep the rollers firmly in place on the particular sector of the drum in which they are functioning, a magnetic pole shoe is attached to each side of the rotating axis of the trolley. Fixed to the chassis in juxtaposition to these pole shoes are a pair of electro magnets. These magnets come into operation when the rollers make contact with the copper, or " live," segments of the rotating drum and prevent the trolley being shaken off by the ship's movements.

Right: Section of course recorder chart showing the steadiness of automatic steering compared with hand steering



Below: Close-up of Brown helmsman bridge unit, showing (centre) the brain unit, breaker switches (top left) and alarm bell (top right)

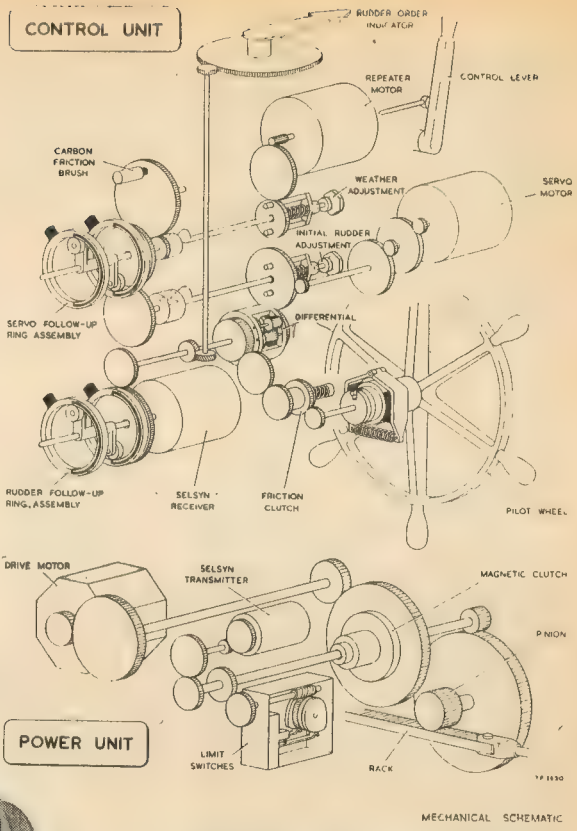


The mechanical helmsman . . . .

Every vessel varies in the amount of rudder she normally needs to check movement. The automatic helmsman caters for this individual characteristic by means of a device called the rudder angle adjustment. Thus the angular amount by which the roller contact bracket can rotate about the drum axis is limited by a projecting arm operated by the control lever of a perforated dial incrementally graduated from 1 to 20. Movement of the control lever to a higher number allows of greater angular displacement of the rudder on the first application, and vice versa.

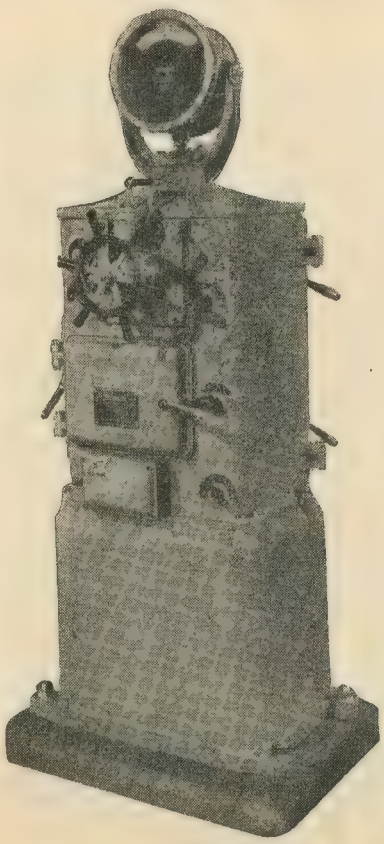
All the pedestal type helmsmen include a hand-steering wheel. For during the change over from manual to automatic steering the vessel's head may fall off. By moving the control switch to "hand" the ship can be brought back and steadied on course with the hand wheel. The switch is then set to "auto" and the robot assumes charge.

This hand steering arrangement also forms a valuable stand-by should the ship's telemotor system break down, for the largest vessel can be efficiently manoeuvred throughout the longest voyage by means of the fingertip control exercised by the 6 in. diameter hand wheel.



Right: Schematic diagram of the layout of the bridge control unit of the Sperry Gyropilot

Below: An S. G. Brown Type E automatic helmsman



The gyropilot

The Sperry Gyropilot is also manufactured in a number of types to cover the various forms of ship steering gears, the control unit being generally similar for each model. Mounted in a pedestal stand in the ship's wheelhouse the bridge control unit of the gyropilot contains a repeater motor activated by the master gyro compass, follow-up ring assemblies, servo motor, a self-synchronous (selsyn) receiver, and lost-motion devices.

The latter, which can be adjusted by control knobs on the front of the bridge unit, introduces a small amount of controlled backlash into the system, the purpose of which—like the contact roller adjustment and the rudder angle adjustment in the automatic helmsman—is to prevent the gyropilot from reacting to normal heavy weather "yaw," and to allow for the varying degrees of rudder required depending upon whether the ship is light or deep loaded.

If the ship wanders off course while under gyropilot control the sequence of events is that the repeater motor armature turns, driving the rollers of the servo follow-up ring assembly through the "weather" lost-motion device. The servo-motor armature is thereby energised and, in rotating, turns the rudder follow-up rings. In addition, it turns the servo follow-up rings through the "initial rudder" lost-motion device—short-circuiting the servo motor armature and bringing it to a stop.

The turning of the rudder follow-up rings completes circuits which close contacts controlling the operation of the after power unit. As rudder is applied, a transmission device turns the rotor of the selsyn receiver which is connected to the rudder follow-up rollers, and their rotation breaks the circuits initially made by the rudder follow-up rings. As the ship's head comes back to the set course, the gyro compass again indicates the movement and the gyropilot's operation is repeated in reverse.

Like the automatic helmsman the gyropilot is fitted with a hand wheel by which the ship may be steered when not in automatic control. In the latest type of Sperry gyropilot, known as the electric and automatic steering control, complete steering control of the ship is exercised through the wheel of the gyropilot, which can be switched to "hand" or "automatic," instead of having two separate steering installations. ▣

Geometer, this week, turns to tensioning and constructing . . . . . .

Chains and sprockets

RESEMBLING single roller chains in main features, double and triple roller types—sometimes "duplex" and "triplex" chains—meet design needs for greater strength and larger bearing surfaces.

At the same time such chains maintain compact drives for the alternative solution, a single roller chain of larger size would involve a longer pitch between the rollers and, consequently, larger sprockets if carrying the same number of teeth. As it is, a double roller chain, *A*, or a triple roller type, merely needs increased width in which to run.

The alternative to double or triple roller chains for neat compact drives is the " silent " or inverted-tooth chain, *B*, which runs on " sprockets " that are virtually gears, *C*. Such chains are built up in any width required from numbers of plates $\frac{1}{16}$ in.-3/32 in. thick, with holes at the required pitch and carrying a pair of teeth on the underside. The plates are assembled on pins, free to pivot, and side plates are pressed on the outside.

Chains of this type were once fairly common for car-engine camshaft and auxiliary drives—as on Packard in recent years and were employed in a few instances for primary drives for motorcycles.

Very strong, a silent chain can nevertheless acquire considerable slackness from the wear of the pins and holes in the plates. On a roller chain pull and wear are always one way across the full length of the pins. On a silent chain the plates pull on opposite sides of the pins, which become nicked or grooved. Thus, width for width, a silent chain has about half the wear resistance of a roller chain.

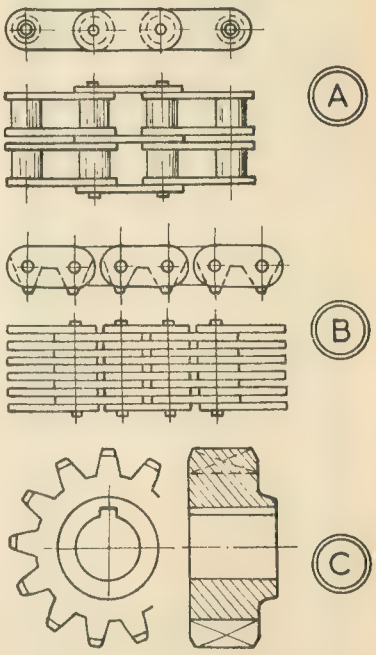
Slackness in chain

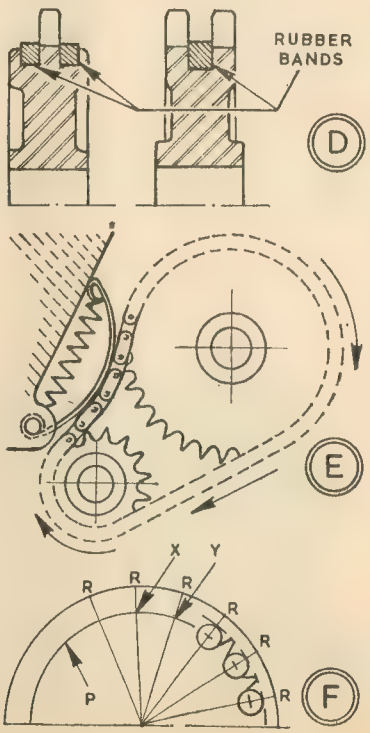
It is, however, perhaps the only chain of transmission type reasonably easy to construct by model makers in true-to-full-size manner. Having drilled, filed and hardened a pair of " master " toothed plates in silver steel about $\frac{1}{8}$ in. thick, the chain plates could be drilled, placed on pins between the plates and filed several at a time. Casehardened, they could then be assembled with side plates on hardened pins, lightly riveted.

On single and double roller chains employed for camshaft drives, tensioners at the present time consist of rubber bands, *D*, sprung into grooves in the camshaft sprockets. The single roller chain requires two bands, one each side of the sprocket teeth, but for the double roller chain a single band is used between the teeth. Deterioration or indentation of these bands permits slackness in the chain—which may be heard as rattle. On occasion, after years of use and hardening, bands disintegrate.

Sprockets from flat plate

A tensioner for either a roller or silent chain may consist of a blade of spring steel, curved and pulled into the slack side of the chain by a tension spring, *E*, and a variation of this type, similarly applied, has a hardened slipper on the end of a spring-loaded plunger. Roller chains may also be tensioned with jockey pulleys, fixed or spring-loaded, on the slack sides.





When required, small sprockets for single roller chains can be made from flat plate, the width of the chain, but ensure the plate is about $\frac{1}{4}$ in. larger than the finished sprocket.

On a lathe having a dividing head (or using a change wheel and indexing plunger to obtain the number of teeth) no calculations need be made. With a pointed tool at centre height, radial lines as at *F-R*, *R*, etc., are made according to the number of teeth. Then dividers are set to the pitch of the chain and applied to two of the lines as *X-Y*, and the tool set so that with a few trial attempts, a pitch circle *P* can be scribed on which the points *X-Y* will be at the intersections of the lines.

These points may then be centre punched, drilled out roller size, and the plate turned off until the holes are just breaking out. The teeth can then be finished with hacksaw and file.

By calculation the following can be the method of finding the diameter of pitch circle on which to drill holes: multiply number of teeth in sprocket by two; divide into 360; from angle thus found in degrees obtain cosecant value in trigonometrical tables; multiply this by pitch of chain. ▣

Modelling extraordinary

H. A. ROBINSON reviews the life work of a famous Yorkshire craftsman

FOLLOWING an early bereavement, Richard Old—who was born in Yorkshire nearly a century ago—turned the whole of his spare attention to the making of highly-detailed architectural miniatures. As time went by the work became practically an obsession and often he would work right through the night and return to business the next day without ever seeing his bed.

One of his best models is of the beautiful cathedral at Milan. Scaled to 1 : 100 it is 5 ft. long, 3 ft. wide and 3½ ft. high. White holly wood was used throughout and during the construction, which took five years, 8,000 separate pieces had to be cut. The cathedral has 126 spires, and each of these has been faithfully copied with its surmounting statuette.

The windows of the model are glazed in stained glass and when lights are switched on inside a striking appearance is produced.

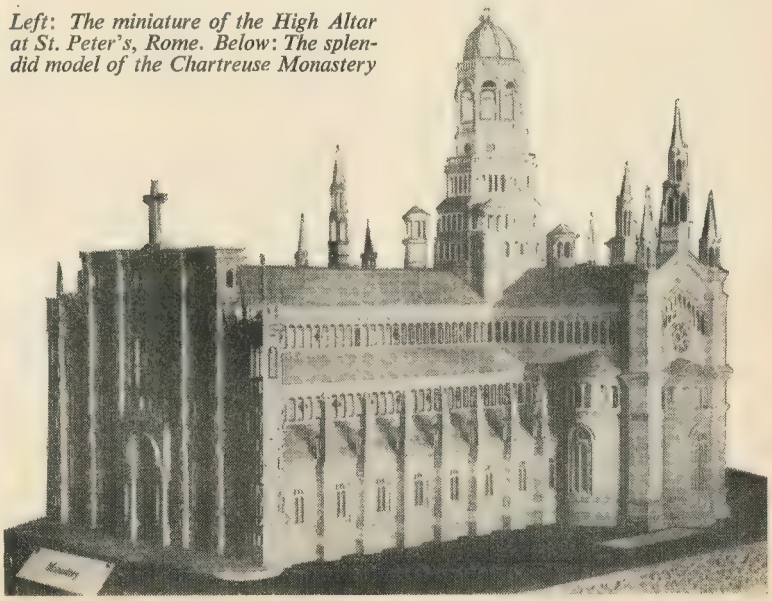
Mr. Old's models now form what is spoken of as the Richold Collection and they are without doubt the finest set of architectural miniatures to be found anywhere.

Coming close to the Milan model in excellence of craftsmanship—and the largest in the collection—is a replica of the Protestant cathedral at Ulm which stands on the left bank of the Danube in Wurtemburg, Germany. Scaled to 1 in 60 it is 8 ft. long, 3 ft. wide and 9 ft. to the top of its graceful spire.

Eight different varieties of wood were used here, including Amarinth, satin wood and black walnut. Ulm Cathedral is the loftiest in the world, its highest point towering 534 ft. above the ground. Its architecture is Gothic throughout (not mixed as in some old churches) and it is claimed that the cathedral holds the biggest pipe organ in Germany.

Another model in this amazing collection depicts the Chartreuse Monastery of Pavia, Italy. Built to the rather smaller scale of 1 : 50, this contains 4,000 pieces—2,000 of which are in the magnificent frontage. This took four years to construct and is almost entirely made of sycamore—

Left: The miniature of the High Altar at St. Peter's, Rome. Below: The splendid model of the Chartreuse Monastery



Left: Mr. Old at work. The saw he is using is of his own design

the only other material being cotton wood, which was introduced round the windows.

Other models in the collection include one of London's St. Paul's, and another of the High Altar in St. Peter's, Rome, and one, which Mr. Old seemed to like best, of Giotto's Campanile, in Florence. The bell tower of St. Mark's Venice, a Chinese temple and a Gothic shrine are particularly fascinating pieces. And among non-religious subjects are the Eiffel Tower and Eddystone Lighthouse.

The Milan miniature was the first of Mr. Old's big efforts and after completion it remained in its case for many years before seeing the light of day.

It was not until 1934 that the now famous collection was "discovered" and put on public exhibition. Scarborough was the first place selected for a showing; since then the models have been seen by more than 1,000,000 people.

It was not easy to get the miniatures out of their various rooms for Mr. Old's house, at Middlesbrough, was quite small. Mr. Old, who was the soul of system, therefore, issued with each model instructions as to how removal could be effected.

These instructions were eventually bound in one book and examples taken at random from this interesting bit of literature read: "Case No. 3. This is made to pass out of the kitchen door into the yard. Proceed as follows to get the model out of the house. Take the lid off the case and lift the model out, pass the case into the yard and then replace the model and screw down before passing through the yard door into the back road."

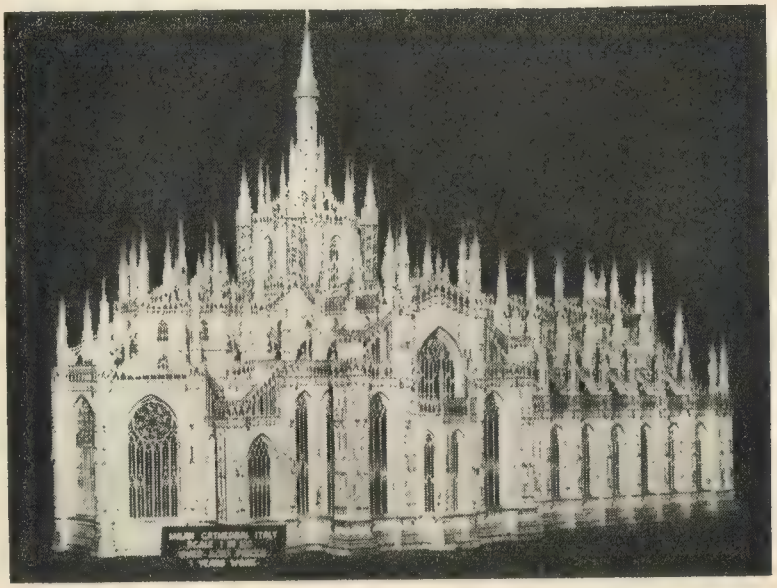
"Case No. 9. The model will be required to be screwed fast before the case can be lifted about . . . it will then pass through the doorway its narrowest way round." And then about another of the crates—Case No. 76. "This will come downstairs with a bit of trouble. It is a trifle narrower one way than the other and this advantage must be used to pass through the door of the staircase—but at all times keep absolutely upright." And Cases Nos. 79 and 80 "must pass through the bedroom window." It is all very precise.

In their journeyings about the country the miniatures have had many adventures.

During the war they were stored at Brighton. A bomb fell nearby and several of the smaller efforts were destroyed. Fortunately, the Milan Cathedral and the other religious models escaped injury. Another near disaster came when the collection was travelling from Dewsbury to Gloucester. A bearing ran hot and the transport men had to load

Right: Eight feet long, nine feet high, this model of Ulm Cathedral is the largest in the collection

Below: The remarkable miniature of Milan Cathedral. It contains over 8,000 pieces, took five years to make



Modelling extraordinary . . . .

into another truck. At Dewsbury the original vehicle had been packed by an expert, but the truck crew did not use the same care and a number of the cases were reloaded upside down. About 30 models received slight damage, but they miraculously were saved from the great damage such inexpert handling could have brought about.

The collection was once more in danger at Burnham-on-Sea. A gale began to rip the marquee in which the models were being shown. Experts arrived on the scene and said that if the damage had gone a foot further the whole weight of the canvas would have been down on the exposed exhibits !

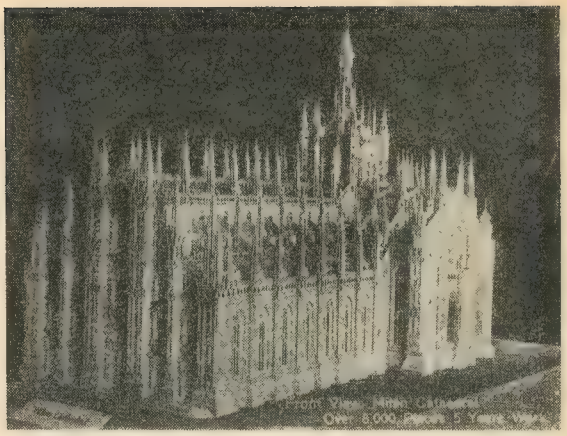
Throughout, the church items seem to have borne a charmed life for on two other occasions they were saved from extinction.

When on show at Minehead a hurricane blew up from the Bristol Channel which brought down a huge tree right across the patch of ground just vacated by the models, while at another place a Press photographer precariously balanced among the collection slipped and was falling backwards with his equipment on to some of the major pieces when he was adroitly caught by a colleague.

Shortly after the collection was taken out on public exhibition a book of comments was started. This now contains many thousands of entries in a score of languages.

The collection has been filmed and examined by many noted architects. All have been amazed by Mr. Old's accurate scaling and ability to reproduce minute detail with such faithfulness. Sir Bannister Fletcher, then president of the Royal Institute of Architects, said: "I will sum it all up in the one word 'marvellous'."

By profession Mr. Old was a cabinet and church organ maker, and at the time of his death he was working on three small pipe organs entirely of his own design. ▣



Front view of the Milan Cathedral model

A SPANNER WITH A DIFFERENCE

TEX shows how to make a handy dual-purpose tool

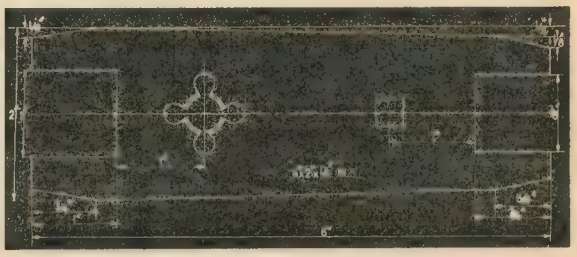
THE COMBINATION TOOL illustrated below was designed for use in a workshop where the only bolts available for holding-down purposes on milling and drilling machines, etc., were almost exclusively salvaged from old textile machinery scrap. As such they were of the square variety, the old Whitworth or heavy and the new or British Standard $\frac{1}{2}$ in. being the most common.

As the ordinary spanner is a poor fit on square nuts the first essential was suitable jaws. These, by the way, were made to size plus 1/32 in. to allow for the variation in size of nuts made from black wrought iron.

The next consideration was some handy means of cleaning up the bolt threads. Being salvage, the majority had either lost their newness by mishandling or were thick with paint; so it was decided to incorporate a die for the purpose. A circle was scribed $\frac{11}{16}$ in. dia. and four equidistant $\frac{1}{4}$ in. dia. holes were drilled, followed by a 13/32 in. hole in the centre tapped $\frac{1}{2}$ in. Whitworth. With a $\frac{1}{4}$ in. smooth round file, the thin wall between the clearance holes and the thread was broken through, thus leaving an efficient die. As it was not intended for cutting new threads it was not thought necessary to give any lead to the die.

Having gone so far it was decided to incorporate a tap wrench. It was found that by drilling with an I drill squaring the hole with a $\frac{1}{4}$ in. square file and finishing off by driving the square end of a broken $\frac{1}{2}$ in. tap—suitably tempered for use as a drift—the result left nothing to be desired.

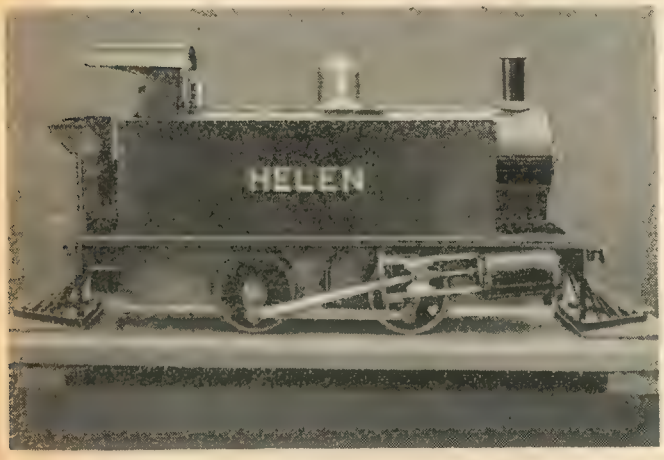
The tool was then carburised and hardened to a depth of about 0.012 in. The outline may not appeal to everyone, but it certainly does the job it was designed for. ▣



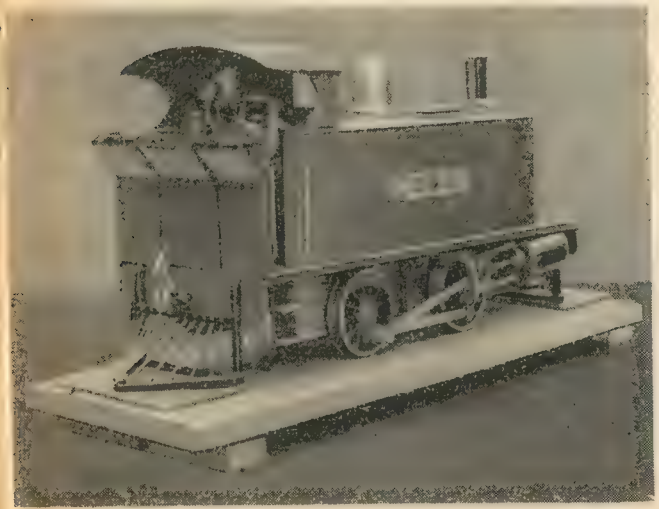
Dimensions of the combination tool

Right: JUMBO, *passenger-hauling petrol-driven loco of the Waikato S.M.E.E., has earned more than £150 giving rides to children. It is built to 7¼ in. gauge*

Below: HELEN, *an 0-4-0 tank owned by the Society, is fitted with traditional New Zealand cowcatchers*

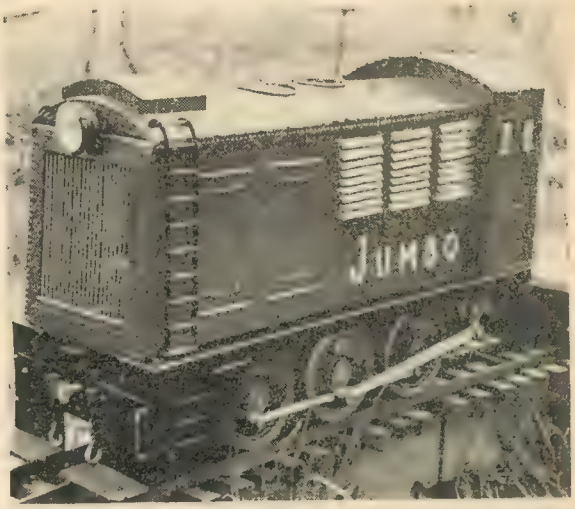


Three-quarter rear view showing the cab fittings of HELEN



G. W. Fife-Johnstone photographs some . . .

New Zealand models



Built by members of the Society, JUMBO *is powered by a 1 h.p. J.A.P. engine directly coupled to a 17½ to 1 gearbox. Final drive is by belt to a tumbler reverse gear*

PART TWO

A bench filing machine

TARENTFORD describes the final operations for those making this useful machine tool

WHEN THE HOLE is bored to size—a pair of inside callipers is used to check the diameter, and a few thousandths of an inch is of no consequence as the bushes are turned afterwards to a drive fit—the body is re-set on the table as depicted in Fig. 6.

The angle plate is set with the aid of the try square, and this should bring it parallel with the lathe axis. Then the body is clamped down on the same edge as before—a setting that will ensure the holes are on the same centres.

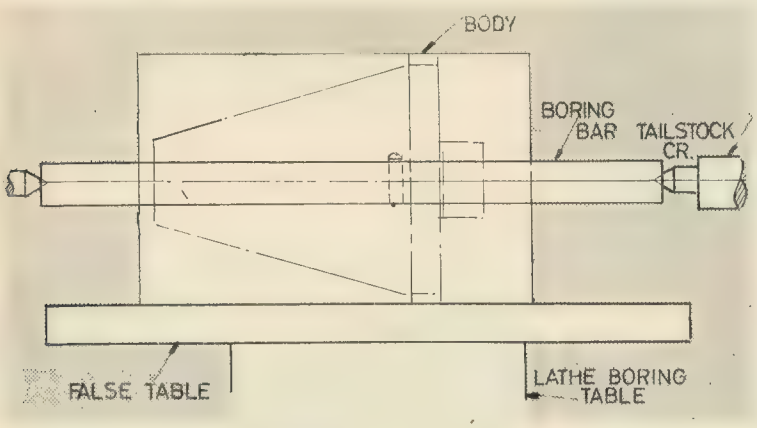


Fig. 6: A set up for the crankshaft bore

While on this matter of setting the angle plate parallel with the table edge you may find it necessary to use a slot rather than the edge because the latter is not sufficiently accurate. The lathe I used was very slightly "out" until I scraped the surface but this is not a job you can accomplish in the proverbial five minutes, so use a slot for setting. A strip pushed into one of these makes a good stop for the angle plate and you can check for parallelism by mounting a mandrel between centres and using slip gauges between this detail and the angle plate.

Slip gauges in the full-size engineering workshops, incidentally, are accurately ground pieces of steel suitably hardened of varying widths, and these are naturally expensive articles to purchase. If a reader measures the thickness of bright mild steel with the aid of a micrometer he will find sections which are reasonably accurate some to even ± 0.0005 inches and these make useful slip gauges even though they are soft.

Pieces of steel accurately milled to width and length are not difficult to make—and a collection of rollers from old roller bearings are another source which you must not overlook. Balls from old races are applied for some jobs, but the difficulty with these is to stop them rolling when checking the part. Silver steel makes excellent plug gauges because this is the most accurate raw material supplied to workshops, but do not confuse it with bright mild steel.

Having made the new setting, the body is clamped securely and the bar once again traversed through the hole—at least the bar rotates and the feed is provided by the table movement when the clasp nuts are engaged.

If you have marked out the body as advised earlier in these notes, the drilling of the securing bolt hole, the tapped hole and the small hole for the lubricator is a relative simple operation. But do ensure the nut seats squarely; lightly skim the top surface prior to drilling the tapping hole.

Keep the lubricator closed when the machine is in use to prevent filings entering the crank shaft bearing. No oiling facilities are provided to the main shaft because this is easily lubricated by smearing it with oil.

The table

The table is a slice of steel bar 8 in. dia., and now having said that I anticipate that few readers will secure such a size though metal merchants will usually sell them such a piece. However, you can easily turn a disc from a piece of flat plate—any off-cut from a scrap yard will do. To machine an off-cut of this nature, set it on the lathe faceplate and drill the centre hole. You can finish bore this while the plate is in this setting, so run two or three cuts through with a boring tool before releasing the clamps.

Turn a spigot to fit this bore and push it into the hole in the lathe faceplate and then drill about three holes in the face of the plate for clamping studs as indicated in Fig. 7. Mount the off cut on the spigot, clamp it securely and turn the outside diameter. Some readers may suggest trepanning the plate but this is not exactly an operation for tyros to carry out and enjoy doing, so I am not specifying that here.

Next weld the two lugs as illustrated in the detail sketch (Fig. 8) and then skim the top surface once again to clean it up. Some may state that the disc will distort while welding and this makes the finished hole out of square with the face. This is correct and you can if you wish skim the bore again, but as the hole is simply for a plug-cum-bush which you only use when the table is flat, this is not really an important matter.

Before attempting this operation you must tap the stud and lubricator holes and decide on the method of

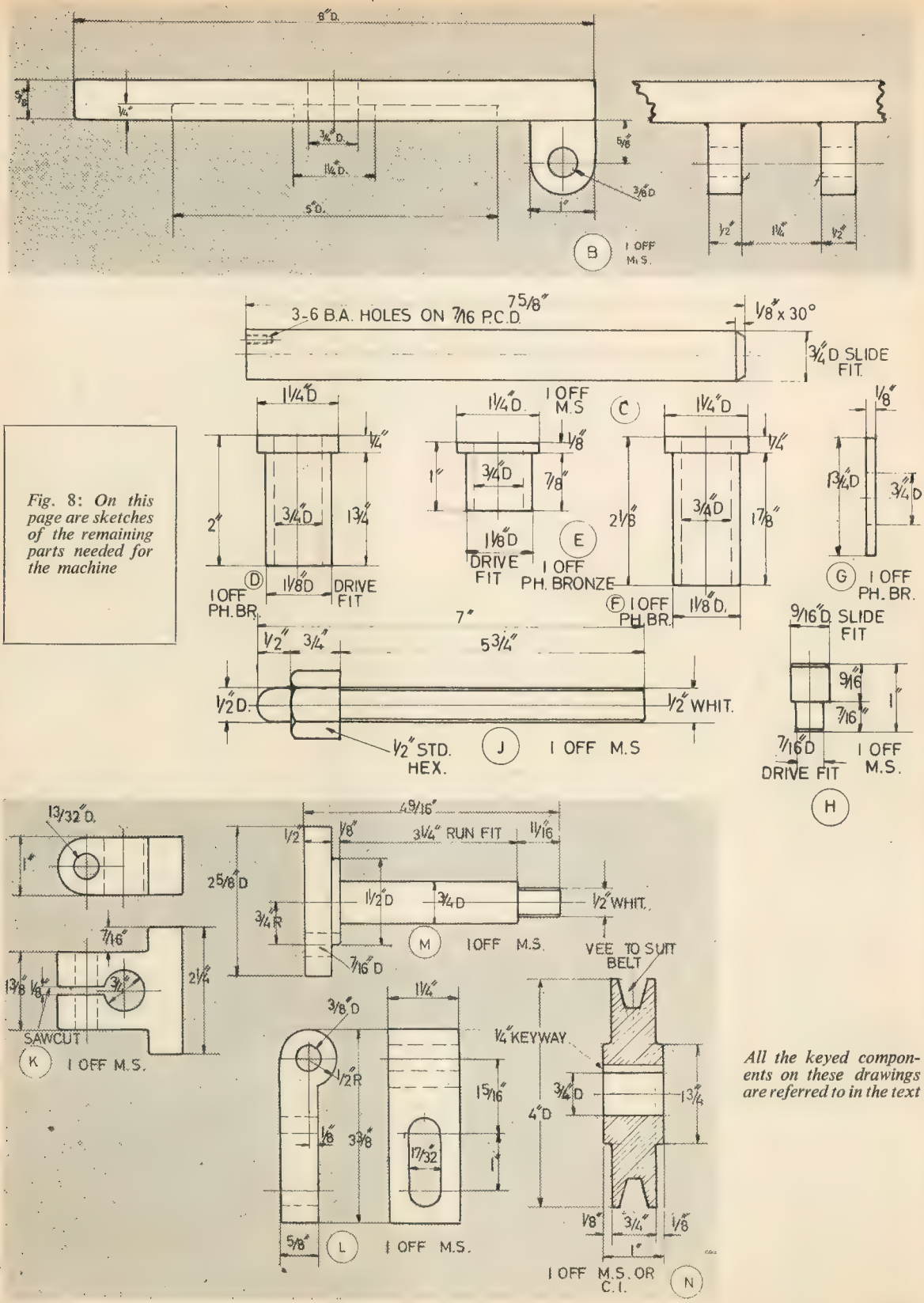


Fig. 8: On this page are sketches of the remaining parts needed for the machine

All the keyed components on these drawings are referred to in the text

A BENCH FILING MACHINE

— part two —

continued . . .

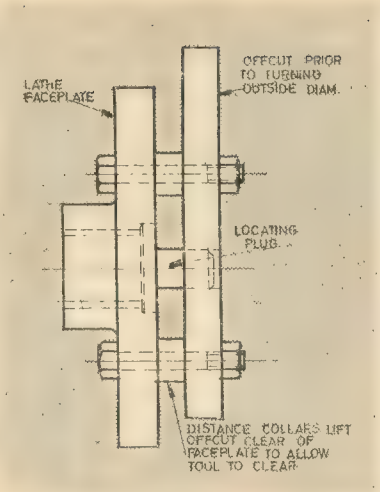

LATHE FACEPLATE
OFFCUT PRIOR TO TURNING OUTSIDE DIAM.
LOCATING PLUG
DISTANCE COLLARS LIFT OFFCUT CLEAR OF FACEPLATE TO ALLOW TOOL TO CLEAR

Fig. 7: The table held to the lathe faceplate while turning the outside diameter

securing this machine to the work bench. I have deliberately refrained from showing holes on the machining drawings of the base because the position depends largely on the site where this machine is operated. I recommend three bolt holes spaced fairly wide apart—two almost underneath the long-screwed stud and the other immediately beneath the pulley; ½ in. Whitworth bolts and nuts will hold the machine, but put washers beneath the boltheads to prevent them entering the woodwork.

This machine will eventually move at about 500 strokes a minute, so unless you intend to vary this and make a multi-vee pulley I advise a check with any existing motor pulley you may possess to ascertain whether it will allow you to "work it in." For this reason the vee pulley diameter is not given, but something about three or four inches, depending on the motor speed, is suitable.

If you decide on a multi-vee pulley then an arrangement similar to that employed for belt changing on the Myford lathes is needed—not a difficult task and one which you can easily arrange at the back of a bench or on the workshop wall. However, there is really little point in this because in actual practice the machine will deal with steel and brass easily —mild steel, that is, and not the tough nickel steels which you might encounter sometimes. The average workshop in the back garden usually manages to avoid these materials. But should you meet such a piece then hand filing is indicated, leaving the machine to tackle the usual type of material.

The files cut downwards and are obtained from any reputable tool dealer. I find about three flat members of different degrees of "roughness" or "smoothness"—whichever you prefer—and a similar number of round files will do all you are likely to encounter. In fact, for almost 90 per cent. of the work you will never change the file. This latter process is easy and requires the slackening of a single grub screw in the top of the main shaft.

Two deflectors are fitted to keep the minute filings out of the file hole (when the tool is assembled) and from the top bearing bush. These items are made from sheet steel—one is spun and the other is bent.

To revert to those holes you drilled in the table to provide clamping facilities; these make good stud holes if they are subsequently tapped and, thus, heavy and awkward articles do not need holding down on the table when the file rises. You cannot permanently clamp the part to the table. No feed is possible if this is carried out, but as the file lifts it can carry the workpiece with it.

On the usual style of filing machine, fingers are arranged to prevent the detail being worked from rising and you can arrange a simple clamp in this manner. A clamp set finger tight, as we say, will still allow you to push the workpiece against the file with the aid of a piece of wood, but for small items this latter "tool" is not necessary.

Well, there is your filing machine —made from what is virtually scrap material and without a great deal of machining or fitting, but it will prove a valuable addition to your workshop. You will even be able to saw with it by slightly modifying the design. ▣

BRITAIN'S MACHINE TOOL INDUSTRY

THE world's first true machine tools were invented in Britain about 180 years ago, when pioneers such as Wilkinson, Bramah and Maudslay—closely followed by others, first discovered and applied the principle of mechanical control of cutting or forming tools to generate true geometric form. The application of this principle—which holds good to this day—ushered in the machine age and made the machine tool the basis of all modern production.

Britain's machine tool industry is, therefore, the parent of all similar industries abroad, but age has in no way impaired its vigour. It remains a leader in its field and the pattern of its structure is followed in all major industrial countries of the world.

There are over 300 firms in Britain officially listed as makers of machine tools. Some employ as few as 50 workers—others have over 4,000 hands. The machines they make range in weight from a few pounds to many tons, in value from a few pounds sterling to hundreds of thousands of pounds for one machine. It takes a few weeks of work by a small number of people to make some, while others call for many months of calculation, complicated design, experiment and draughtsmanship, together with the skill of many workers, over a long period of time before the job is complete.

Modern production engineering calls for literally hundreds of differing machine tools. Some are required in large quantities, others in small lots or single units. The demand for some types is continuous; for others, spasmodic. The key to the pattern is specialisation, which became technically and economically desirable as the demand for machine tools developed. Today, concentration on one type or a limited number of types is universal practice. ▣

Locomotive constructional details

By G. Woodcock

PRIOR TO 1858 the English locomotive frame was produced by bolting axle-guards to a rectangular bar. Later they were fire-welded on, thus making a stronger job (Fig. 1). But by 1868 the rolling of iron plates of such size as to produce a solid frame from one plate rendered the older method obsolete.

The use of steel plates for frames was introduced first by Webb at Crewe in some small 2-4-0 tanks which were later rebuilt to his well-known 2-4-2 type. The introduction of the steel frame came in 1876.

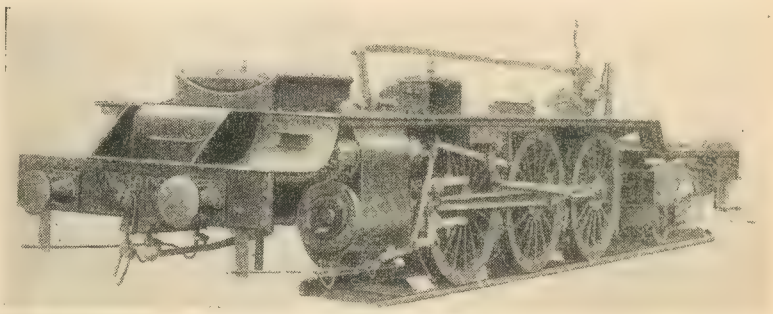
The G.W.R. practice long adhered to the flitch frame with teak packers; as late as 1889-91 W. Dean built 62 engines thus. The main cause of its long continuance on the G.W.R. was the old " baulk road " which had not the resilience of the cross-sleepered road.

The English plate frame was for many years, and even in the writer's young days, punched out by chain punching under a powerful punch. The frames were then machined six at a time on a traversing head puncher slotter. The first gas-cut frames were produced by Messrs. Andrew Barclay of Kilmarnock about 1912. An English plate frame is shown in Fig. 2.

In 1829 Edward Bury produced his second locomotive, *The Lion*. This engine had bar-frames. The bar-frame, now standard in America, was taken there by the introduction of certain Burry-designed engines supplied by Braithwaite and Ericson of Marylebone Road, London in the 1830-40 period.

The making of American frames of this kind, until 1853, was in one piece; the splicing of the frame, as shown in Fig. 3, was introduced by Wilson Eddy, master mechanic of the Beston and Albany in his *Lowell*. It may be noted, however, that the bar-frame is always claimed as Bury's. The " brains " behind Bury was his foreman, later partner, Edward Kennedy, who designed most details. Today, the cast-steel frame or bed, with or without cylinders cast integral, is much in use in America.

The earliest and, for many years, only type of hornblock was in the nature of two cheeks bolted to the axle-guards. The first use the writer can discover of the horseshoe hornblock in cast steel was by Patrick Stirling in 1870 on his 7 ft. 7 in. Single engines, though Sinclair used cast-steel horncheeks on the G.E.R. in 1862.



Above: *A 10¼ in. Pacific under construction. Note the wheel centres and side and main rods*

A modern cast-steel wedge horn is shown at Fig. 4. Horncheeks (Fig. 5) are still in use in certain cases, such as where the firebox would foul a normal horseshoe hornblock, as in a 4-4-0. The old North London 0-6-0 tanks were fitted with them. Where cheeks are used, a greater depth of frame above the aperture is desirable. Their use on bogie and tender wheel axleboxes is of course, obvious.

In American practice, the bar frame, of course, provides its own hornblock or, as it is called in America, pedestal, the hornstay being known as a pedestal-tie.

Axleboxes

The earliest axlebox consisted of a U-shaped brass, with a bolt passing below the axle. The use of the keep, with a sponge or pad to retain oil, was introduced by Robert Sinclair on the Caledonian Rly. in the 1840 period. A solid bronze axlebox with c.i. keep is shown at Fig. 6.

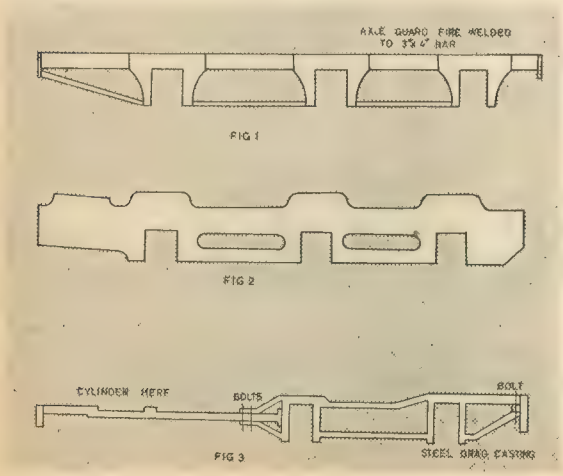


Fig. 1: *Design of a fire-welded frame*

Fig. 2: *Layout of an English plate frame*

Fig. 3: *The American-type bar frame*

Locomotive constructional details . . . .

The faces and bearing crown are lined with white metal, thus the box may be re-metalled and used again and again until it cracks or wears too much on the fillets. Webb introduced the system of re-boring and planing worn boxes off one engine to fit another class, thus obtaining twice the life between re-metalling. When new, a box is fitted to bear only in the crown of the journal, never on the sides.

Fig. 7 shows a box with inserted bearing-cap as fitted to L.M.S.

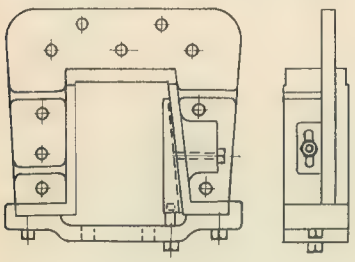


Fig. 4: A modern cast-steel type of wedge horn

standard tanks and also in the United States. A continental design was that which had an adjustable wedge integral with the box itself.

Axles, were, until the 1860s, of Lowmoor or Farnley iron. In 1851 Krupps produced steel axles. Connor, in 1859 on his 8 ft. 2 in. Singles, used cast-steel axles which broke in service, the journal diameter being only 6¼ in. From 1863 the Taff Vale Rly. used steel axles. Webb, on the L.N.W.,

Right: A 9½-in. gauge Single illustrating wedge horns and cylinders

Below, Fig. 5: Typical form of horncheeks. They are still in use today where a firebox would foul a normal horseshoe-type hornblock

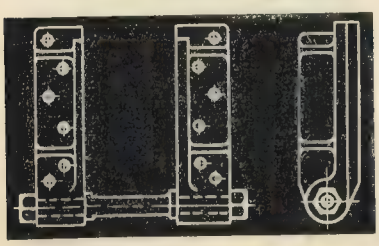


Fig. 6: Details of a solid bronze axlebox

Fig. 7: Box with inserted bearing cap. These were fitted to L.M.S. standard tank locos.

Fig. 8: A modern coupled axle. Its braking strain is 80,000 p.s.i.

Fig. 9: American axle with loose collars set-screwed up to the boxes

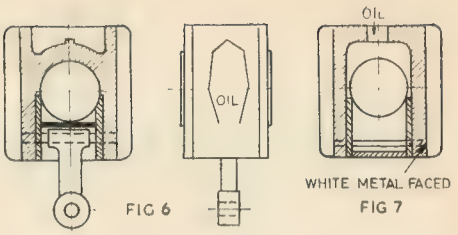


FIG 6 FIG 7

FIG 8

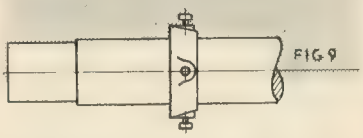


FIG 9

also made great use of steel axles, but he had had exceptional experience as manager of the Bolton Iron and Steel Co.'s works.

A modern coupled axle is shown in Fig. 8. In the writer's youth one got 24s. for turning from billet at piece-work rate, and £5 for a double-throw crank. A modern axle would have a tensile strength of 80,000 p.s.i. with 20-25 per cent. elongation. The maximum bearing load in British practice is 224 p.s.i. of journal area. American axles are mostly straight, having no radii but loose collars set-screwed up to the boxes (Fig. 9).

Crank-axles

The first engine with a crank-axle, if we exclude *The Novelty* of 1829, was Hackworth's *Globe* of 1830. For many years, crank-axles were built up by "faggoting" on the throws under the hammer; that is, to tie pieces of plate together and raise to welding heat and weld to a square bar.

Various methods of strengthening crank-axles have been introduced. Sturnock introduced the shrinking on of hoops to the webs, a method still in use; S. W. Johnson drilled the crankpin and passed a 2 in. bolt through it; Ivatt on the G.N.R. used the crank-axle shown at Fig. 10 in his compound Atlantic.

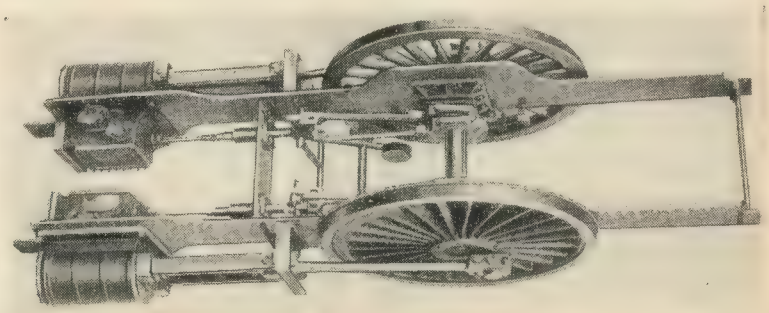
Of late years the system of building up by shrinkage of the entire crank has been greatly in use. Drummond used the method on his 4-6-0 *Paddle Boxes*. The journal diameters were 7¾ in., the crank webs being 4⅜ in. thick on the webs next to the axleboxes and 5⅛ in. on the inner webs.

With built-up cranks it is essential to keep the webs as wide as possible; Unwin gives this as ⅜ journal diameter, but about 15 years ago the P.L.M. fitted some 4-8-2 engines with built-up cranks with 4 in. web. All had to be taken out at 60,000 miles. Other engines using built-up cranks are: the L.N.E. A1 4-6-2, K3 2-6-0 and G.C. Directors; L.M.S. Royal Scots; Southern Lord Nelsons and certain G.W. engines, among them class 57XX and 66XX (0-6-0 and 0-6-2 tanks).

The usual shrinkage allowance on the bore for a normal crank is from 0.020 in. low to 0.017 in. high; in addition, prior to the pin or axle being entered into the heated web, it is in some shops coated with sal-ammoniac; also screwed pins 1½ in. dia. by 6 t.p.i. are fitted half in the axle pin and half in the web.

Built-up cranks are also in use in America in certain 4-cylinder engines, notably the N.Y.C. Mountains. But here it is usual to step the pin or journal into the webs.

For many years on engines from the earliest times cast iron was used for wheel centres; one of the last surviving examples of a cast wheel was to be seen in the North London



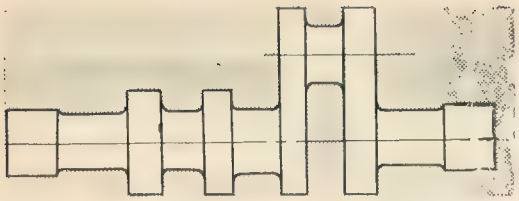


Fig. 11: *Standard crank without hooped webs*

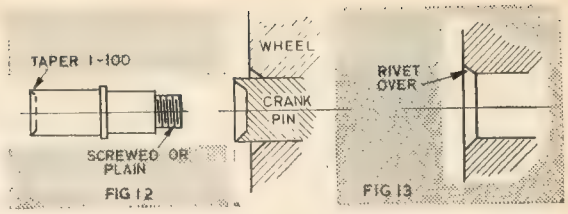


Fig. 12: *Crank pin.* *Fig.* 13: *Crank-pin fixing*

Rly. 0-6-0 "Shunters" by Park at Bow, 1879 and onwards. During the recent war it was again used for certain engines, but their speed was limited to 35 m.p.h. The wrought-iron built-up wheel which was so much used during the last century represented the highest form of the smith's art, in view of the fact that it was hand-made.

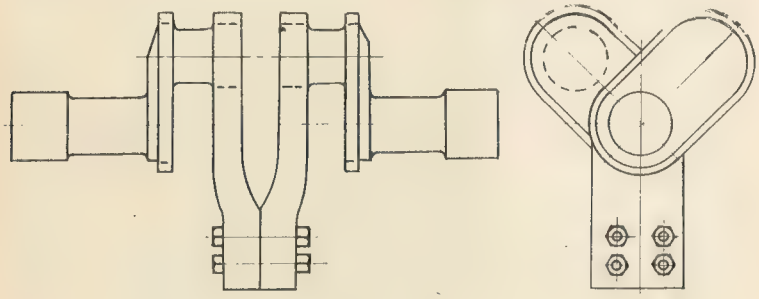


Fig. 10: *Ivatt's Great Northern built-up axle*

It may be of interest to describe how wrought wheels (Fig. 17) were produced. The spokes were formed to shape by means of a top and bottom tool under the hammer; to them was then welded a segment of the rim. The driving boss crank parts, etc., were then forged under a 3-ton hammer.

Balance weights of three spokes or less were forged in one piece; if more than three spokes, they were forged in single portions and glut-welded to the rim. When the foregoing parts were completed they were assembled on a circular slab and looped together with a band bolted in two halves. The wheel so formed was then heated at a circular fire on the boss and raised to welding heat, a washer the shape of the outside boss being then welded on under a 2-ton hammer.

The wheel was then turned over and a washer the shape of the back welded on at a second heat. The rim was then set and bevelled on the slab for the last operation, which consisted of glutting, or welding-in, the segments to complete the rim; these were small V-shape pieces between each spoke, except at the balance weight (if any).

One glut was left out until the wheel cooled, to allow for contraction; the glut was then put in. After this the entire wheel was brought to a red heat and flattened all over to a smooth finish.

The cast-steel wheel (Fig. 18) was first introduced on the Taff Vale Rly. in 1885; it brought about the disuse of the wrought-iron wheel, the last of which was made in 1900 by Beyer, Peacock and Co.

The writer during his youth, however, obtained the foregoing from an old smith who had worked upon built-up wheels. The cast-iron wheel with H-section spokes was at one time favoured by Webb, who built about 1,400 goods and tank engines thus. It also had some use on the G.S.W.R. of Ireland, the N.L.R. and the G.W.R.

The use of the crescent balance weight to reduce hammer blow was introduced on Conner's 8 ft. 2 in. Caledonian Rly. Singles of 1859. In America, the use of the cast-iron wheel continued for a good many years.

Wheels are usually forced upon the axles at a pressure equal to 10 tons per inch of the axle diameter; thus, an 8 in. journal or wheel seat should require 80 tons.

In a paper before the Institution of Mechanical Engineers, Stroudley stated that he had dispensed with keys between wheels and axles, but was using a pressure of 12 tons per inch of axle diameter. When new, the

Right: 7¼ *in. gauge G.W.R. Single showing double framing*

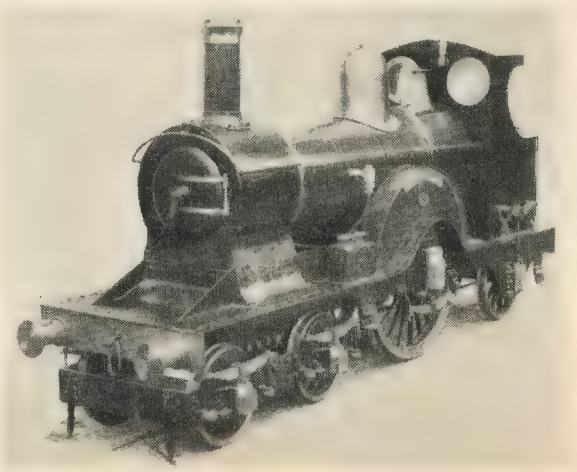


Fig. 14: *Modern jointed side-rod.* *Fig.* 15: *Fairbairn's rod,* 1850

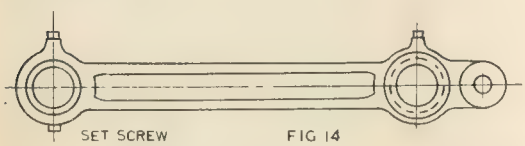
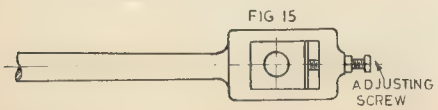


FIG 14

FIG 15



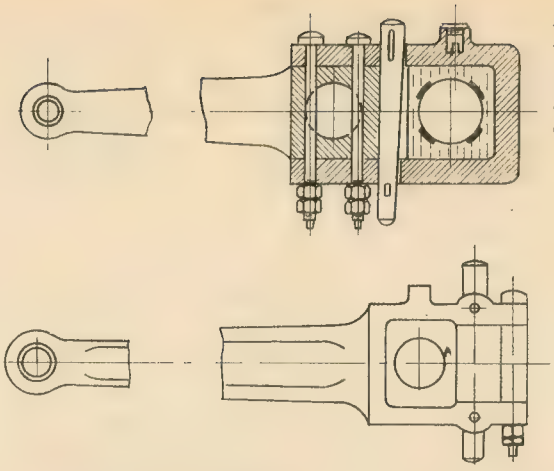


Fig. 16: The top design shows an inside cylinder connecting rod, the lower shows an outside connecting rod with an adjustable G.N. big end

crank-pin holes are bored in the wheels on a quartering machine which bores the holes and locates them in relation to each other. This is done when the wheels are mounted upon the axle.

The crank pins (Fig. 12) are fitted into the crank-pin bosses with a very slight taper and riveted over after (Fig. 13). The end of the crank pin is cut out or recessed while in the lathe, and it is then knocked down into the countersink when fitted.

This method of pin fitting is very common, two other instances which come to mind being the bridle rods on the reversing shafts of the North London "Shunters" and Adams' 7 ft. 4-4-0s L.S.W.R. Crank-pin retaining washers are usually screwed on, but plain push-on washers are sometimes used; in both cases they are secured by a taper pin. At one time crank pins had spherical ends—Stephenson's and Bury's, for example.

Main and side rods

In all earlier engines these were of round section with strapped ends. Prior to the use of steel they were made from best Yorkshire hammered scrap.

The rod (Fig. 15) by Fairbairns had thin insertions of rubber fore and aft of the brasses supposedly to counteract mal-adjustment of the brasses by the fitters.

In 1866 Ramsbottom, at Crewe, introduced plain bushed ends. His bushes were of cast iron, lined inside and out with white metal. In 1882 T. Worsdell, on the Great Eastern, introduced the channelled or I-section rod (Fig. 14). These rods had, however, been used in America in 1867 by the Grant Locomotives Pattison N.J. and also by the Rogers Loco Works.

Stroudley on the L.B. and S.C.R. made extensive use of the marine-type big-end, as did Sacré on the M.S. and L. Rly., and D. Drummond made some use of marine big-ends when on the L.S.W.R. Adjustable rods, either main or side, are rare today except in the big-ends of inside-cylindered engines and the side rods of contractor's engines, as it is cheaper to turn a new bush than run the risk of over-heating from a badly adjusted brass.

Leading and trailing bushes are usually made from 1/64 in. to 1/32 in. slack on the pins, the bushes on the main crank pins being about 0.010 in. free, as also applies to inside cylinders.

Inside brasses are pocketed with white metal; but the bugbear of white-metalled bearings is "spread," to obviate which the L.M.S. have lately resorted to lining thinly about $\frac{1}{8}$ in. to 3/32 in. to counteract this trouble.

When fitting these, it is usual to scrape the intervening brass below the white metal so that, at first, the big-end bears only on the white metal until it beds itself in.

The boring of side-rods is done on horizontal boring machines, the checking of centres being from the boxes when in the frames, known as "trammeling the rods." The boring of inside big-ends is usually done on a large lathe, with the big-end removed from the rods; this is on account of the large radii which are formed with handed r. and l. radius tools.

Cylinders

Cylinders are usually of cast iron, though some companies—for example, the L.M.S.—have fabricated them by welding. A cylinder casting is rather complex, having a fair number of core-boxes in connection therewith.

The life of a cylinder is about 12 years in normal use; during this time, it will have been bored out three or four times. Scrapping wall-thickness is about $\frac{7}{8}$ in. When the cylinders are fitted to the engine, they are not again removed until they are condemned. All reboring and facing of port-faces is done with portable equipment in the erecting shop.

Cylinders sometimes crack in service, either through the port-bars or in the barrel. The writer has spent many hours stopping and screwing in $\frac{7}{8}$ in. × 11 t.p.i. stays 2 ft. long through the bars. The early cylinders and, for a good many years in America, the valve-chests were made separate from the cylinder proper, as in the *Rocket*. The American method of supporting the smokebox on the cylinders, as is now common in this country, was introduced on the G.W.R. by W. Dean, in the first instance. Figs. 20 and 21 show an outside cylinder for a 4-4-0 tank.

At one time in England, 1898,

Fig. 17: Coupled-wheel centre for light 4-4-0 tank engine of Cork, Bandon and South Coast Railway

there were no companies building outside-cylinder engines except the North London, and the London, Tilbury and Southend. The machining in the first instance, in, say, the case of an outside piston-valve cylinder, would be the machining of the bolting faces to form a datum. Then mark off, boring barrel and piston valve on the horizontal borer, and machining the barrel and piston valve faces. The casting is then up-ended on a large vertical miller and the outside profile milled. Marking off, drilling and studding completed, the piston valve liners are inserted. When the cylinders are completed it is usual to blank off all openings and subject the finished cylinder to hydraulic steam pressure.

Fig. 18: *American cast-steel centre*

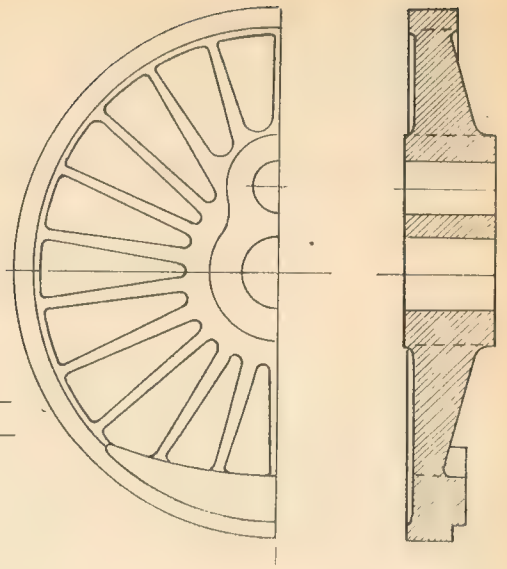
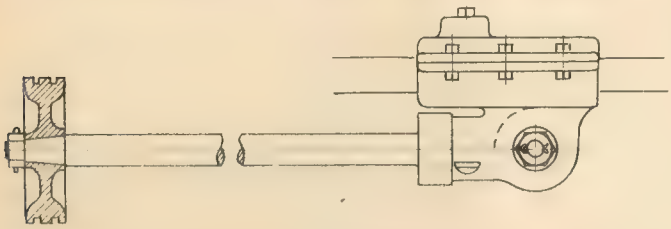


Fig. 19: *G.E. type single-bar crosshead*



Pistons may be of cast iron with Ramsbottom rings, or of a steel annular ring on a cast centre. The piston head is fitted to the rod on a taper and nutted with, usually, an octagonal nut, which is tightened with a ring spanner and a 14 lb. hammer.

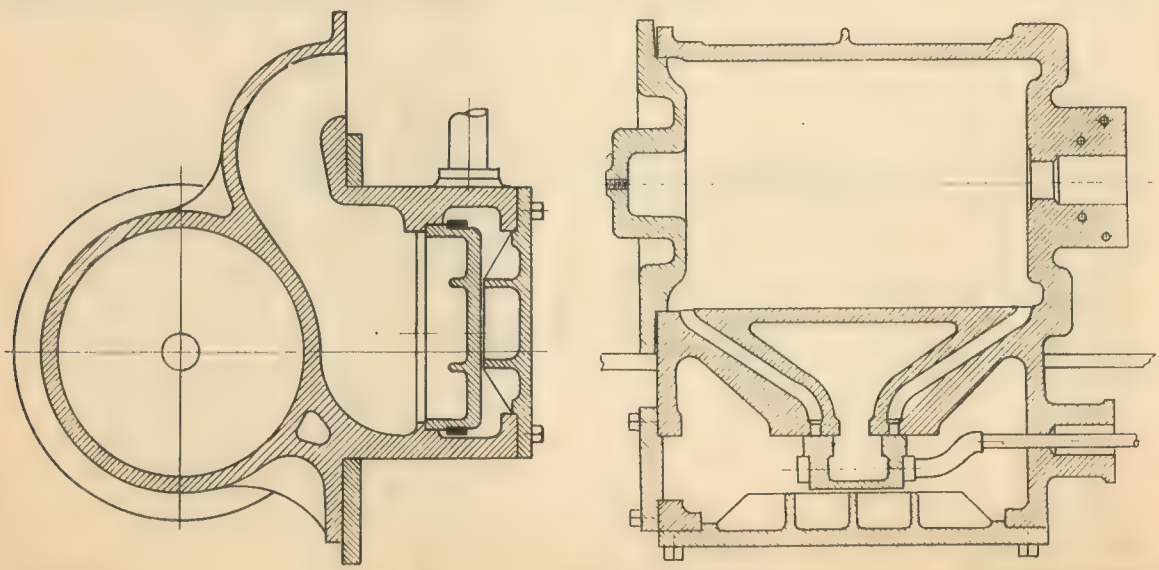
The crossheads (Fig. 19) are also fitted taper, though some of the older L.N.W. engines had the rod fitted parallel and double-nutted. Crossheads are of a variety of types, that shown being of Adams' single-bar type, though when on the North London, Adams used the 4-bar type with cast slippers. Incidentally, we used the discarded ones as packing blocks on shaper and planer. Until the advent of cast-steel and steel castings, nearly all crossheads were either four- or two-bar type, and were forgings.

The introduction of steel castings has made possible the making of crossheads of the Laird and similar types. In some crossheads, especially of the single-bar type, inserts or slippers of bronze are sometimes used. When erecting, it is usual to fit up the slide-bar and crosshead and then cotter the piston-rod up. For this reason, heavy crossheads such as the single Adams and large Alligator types are not popular with erectors.

In the foregoing, the constructional details of locomotive work have only been lightly touched on; as regards valve-gears, etc., perhaps with the permission of the Editor I may deal with them at a later date, together with the vexed question of valve setting as done in the erecting shop and not in the text-book.

The photographs show some of the writer's engines which embody some points discussed in these notes. ▣

Figs. 20 *and* 21: *Cross-sections of outside cylinder for a* 4-4-0 *tank engine*



L.B.S.C.'s 'SHOP CHAT'

A friendly dissertation on matters concerned with locomotive design, construction and maintenance

VARIETY, it is said, is the spice of life and, as the subjects discussed in the enginemen's lobby naturally vary from those talked about in the shopmen's messroom, I thought the above heading would be more in keeping with this week's items of general interest.

From time to time the question of wear in locomotive axleboxes of 2½ in. and larger gauges has come to the front. The axleboxes of a small passenger-hauling engine have a very strenuous time—far greater in proportion than those of a full-size relation—and even when properly fitted in the first place slackness will in due course be apparent. Not only do the journal holes wear but also the sides of the boxes, the latter depending on the alignment of the track.

It is safe to assume that there is not a small railway in the country on which the rails are as level as the proverbial billiard table; they consist of what the children would call a succession of "'umps an' 'ollers," which means that during the whole time that the engine is running the boxes are bobbing up and down. As the coupled axleboxes also transmit the driving stresses it is easy to see why excessive wear takes place especially when the owner of the engine does not take precautions to keep the boxes as free from ash and grit as possible.

I try to keep my own little railway levelled up but it is a hard fight against the vagaries of the British climate, especially with a road laid on wood longitudinals, and I have had to undertake plenty of axlebox maintenance.

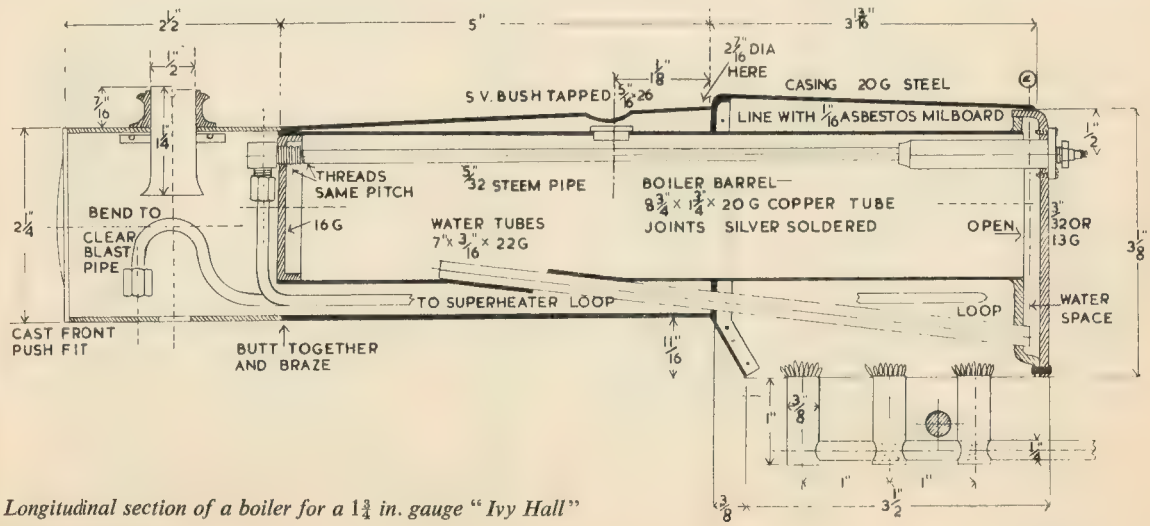
Following full-size practice

In most of my specifications I have stressed the need for good hard metal—such as cast or drawn bronze or gunmetal—from which to make the boxes. I have also arranged for these to run in wide-faced hornblocks, the old idea of fitting a grooved axlebox into a plain opening in the frame (frequently seen on commercially-built engines) proving unsuitable.

I am now going a step further and have fitted one of my engines with a set of mild steel axleboxes with the holes for axles bushed with phosphor bronze. As the sides of the boxes will bear on newly-faced bronze hornblock jaws, I am hoping that it will be many moons indeed ere wear takes place sufficiently to cause knocking. The sides of the axleboxes of many full-size locomotives are now furnished with liners of manganese steel and should the steel boxes not last as long as I anticipate I shall fit liners of hardened steel in the grooves.

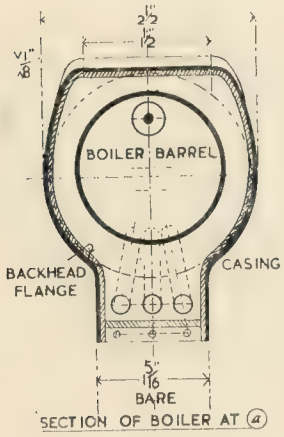
I am also trying a set of plain cast-iron boxes. These will not be bushed; the axles will run in holes truly reamed in the cast iron. This metal is good for bearings; I once had a lathe with cast-iron mandrel bushes and they were quite all right. The bores were as smooth as glass and had become quite hard with use. If the rubbing faces of the cast-iron boxes which work in the hornblock jaws do likewise, there should be no appreciable play for a long period of service.

Two of my engines, *Ayesha* and *Tishy*, are champions for wearing out trailing boxes. The former, being a



Longitudinal section of a boiler for a 1¾ in. gauge "Ivy Hall"

4-4-2, has ordinary boxes, but 4-6-2 *Tishy* has radial boxes and the combined up-and-down and sliding movements have played the dickens with both axleboxes and hornblock jaws. In *Ayesha's* case, incidentally, Stroudley's assertion that the trailing wheels guided the engine seems to have been conclusively proved in the small size, for she has worn out three pairs of trailing axleboxes and the treads of the wheels have had to be trued up, while the flanges have worn so thin that I shall fit a fresh pair of wheels as well as new boxes—cast iron this time. Although the bogie carries its share of the weight of the engine, neither the bogie axleboxes nor the wheel



SECTION OF BOILER AT (A)

treads and flanges have worn to anything like the extent just quoted, which is certainly significant. The little engine has worked very hard during its many years of existence.

One correspondent whose locomotive was suffering from badly-worn journal holes inquired about the possibility of drilling out the axleboxes, filling the holes with white metal as used for main and big-end bearings on automobile engines, and drilling and reaming to the original size. He said that the bearings in his car engine got probably more of a "doing" in one day's running than the locomotive bearings would get in the whole of its lifetime.

This is quite all right; I have done it myself in days gone by, when I was able to do a few repairs for friends. The *modus operandi* is very much the same as a motor fitter would do when re-metalling connecting-rods.

After drilling out the holes I cleaned all grease off the boxes and thoroughly tinned the inside of the holes. The boxes were then heated up to the melting point of the bearing metal, some paste flux was applied and the melted bearing metal poured in, the boxes being placed on a sheet of asbestos millboard. The boxes being small, they were filled up solid, no coring being needed. When the metal had set the boxes were smoothed off at each side and the holes were set out, drilled and reamed—exactly the same as would be done in the case of new boxes.

As a matter of fact I fully intended to white metal the steel axleboxes, using some metal melted out of the big-ends that were taken out of my car when she was rebored at the beginning of the year, and the process would have been the same. But lack of time prevented this, so I fitted the bronze bushes for quickness. Just a word of warning; anyone who uses white-metalled axleboxes should bear in mind that they need to be kept well lubricated. I called my correspondent's attention to the fact that one reason why his car-engine's bearings stood up to the job was because they were always running in an oil bath.

More "automation"

As my few personal friends well know my workshop is a pretty good example of what is implied by that overworked term "automation" inasmuch as every machine and appliance in it is intended as a means of saving time. Production was speeded up when that genial person whom I nicknamed "Bro. Myford" sent me one of his "supersonic" lathes with nearly every accessory in the catalogue. Recently he added a final touch by sending me a gearbox and metric conversion set for it.

In a covering letter he asked me to let him know when I had fitted it—and I rather fancy my answer was a bit of a surprise! The outfit arrived about 11 a.m. so I unpacked it right away, took a good look at the contents, wiped the grease off, and got busy as soon as I had finished my midday meal. It was 2.35 p.m. when I started taking off the original gear cover, and the whole job was done by 5.30 p.m. I tried out the gearbox after tea, and everything worked perfectly—which speaks well for the workmanship that the Myford firm puts into its products. I had never seen one of the gearboxes "in the flesh" before and had to drill and tap the holes for fixing the box. But everything fitted, and no adjustments were needed.

"Ivy Hall" valve gear usage

My only previous experience of lathes with gearboxes was when I was over in the U.S.A. some 25 years ago, when I used both South Bend and Norton machines, and I often wished that I had one on my Milnes lathe. The screwcutting changes are very little used in building small locomotives, but the variations in the fine feeds are very valuable indeed, especially in jobs such as boring cylinders.

Readers often ask if certain components which I have specified for some particular locomotive could be adapted to one of another type. A correspondent of long standing recently wrote that he was building a big 3½ in. gauge engine with the 4-8-2 wheel arrangement and had a pair of *Princess Marina* cylinders which he intended using; but as one of the jobs for which the locomotive was intended was hauling loads of children and there might possibly be derailments, he wished to use inside valve gear. Would the link motion specified for *Ivy Hall* be suitable and would any modification be needed?

The eccentrics, straps, rods, expansion links, suspension links, lifting links, weighbar shaft and brackets can be used on any engine, just as described for *Ivy Hall*, without alteration, provided that there is sufficient room between the coupled axles to accommodate the complete assembly. The only variation would depend upon the cylinders. In the case mentioned the valve spindles of the *Princess Marina* cylinders are offset away from the frames, instead of towards them as on *Ivy Hall*.

Therefore, the rocking-shaft bearing would have to be extended to bring the valve link in line with the valve spindle, or, alternatively, a valve link with a double bend in it used in place of the straight one. The former is preferable. The length of the inclined connecting link inside the frames would have to be arranged to keep the suspension lever and inside pendulum lever parallel; this measurement is easily obtained from the actual job.

If cylinders with steam chests inside the frames are used, the rocking shaft is not needed, and the inside connecting link can go straight from the bottom of the suspension lever to the fork on the valve rod.

"Ivy Hall" in 1¾ in. gauge

The usual requests have come from owners of 1¾ in. gauge lines asking what alterations would be needed to build a small version of *Ivy Hall*. The principal dimensions can be halved; use 16-gauge steel—or brass if desired—for the frames and 3/32 in. angle for the beams. The frames can be silver-soldered into the slots in the beams. If the engine is intended for hauling a train of coaches on a "scenic" line, the whole box of tricks can be considerably simplified. No sprung axleboxes would be needed, the axles running in bronze bushes pressed into holes drilled in the frame. This obviates any need for

knuckle joints in the coupling rods, so each can be made in one length.

Slide-valve cylinders can be used $\frac{9}{16}$ in. bore and $\frac{7}{8}$ in. stroke—with loose-eccentric valve gear, which should be arranged to cut off at about 60 per cent. of the stroke. This setting would give economical steam consumption with good starting, and there is no need for a variable-expansion gear when the engine runs alone and unattended. There is also no need for reversing from the cab—it is seldom that a tender engine makes a "service" run with the tender leading. In this small size the less pin joints that are in the valve gear the more efficient the engine will be and the longer it will run without repairs.

Boiler for Ivy junior

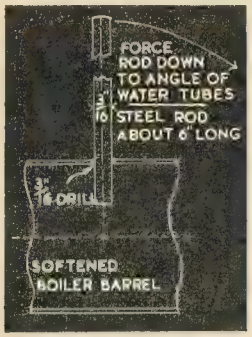
The simplest kind of boiler for a long non-stop run without any attention, when the driver is not riding with the engine, is the water-tube type, either oil or spirit fired. A drawing of a suitable boiler is reproduced with all the dimensions on it. The boiler shell, or outer casing, should be made from 18 or 20-gauge steel, which does not conduct heat as well as brass or copper. It should be lined with thin asbestos millboard as an additional help to keep in the heat; the more heat that is wasted through the casing—some loss is obviously unavoidable—the less is available to generate steam. The smokebox front can be a casting, turned to a push-in fit, with the dummy door and hinges being cast on for the sake of appearance. The thin steel boiler shell can easily be brazed up with a one-pint blowlamp or a small air-gas blowpipe of equivalent power.

Fitting the backhead

The actual boiler, which fits into the casing, should be of the wet-backhead type. This allows the fittings to be attached in the same way as those on a coal-fired boiler. The backhead is flanged up in the manner described for the 3½ in. gauge engine, using 3/32 in. or 13-gauge copper so that fittings may be screwed in direct. After the ragged edges have been filed smooth, a 16-gauge copper plate of similar shape is fitted inside the flange and brazed in position, the bottom edge being bent inwards and riveted to the backhead. This not only keeps the parts together while the brazing is in progress, but acts as foundation ring.

A large hole is cut in the upper part for the boiler barrel and holes are drilled for the water-tubes, which are straight. The barrel should be made from 20-gauge seamless copper tube, and the water-tubes should not be thicker than 22-gauge. With this type of boiler, especially when spirit fired, the less metal there is to keep hot the greater the efficiency of the boiler.

The front end is closed by a flanged disc of 16-gauge copper. This, and the joint between barrel and backhead assembly, should be silver-soldered



How to "set" water-tube holes in the barrel

with B6 alloy or its equivalent while No. 1 grade, or Easyflo, will be best for the tubes. The boiler is held in place in the casing by a few brass screws run through clearing holes in the edge of the firebox casing into tapped holes in the backhead flange.

The fittings should be kept as simple as possible. The regulator is merely a screwdown valve fitted in the backhead, the steam pipe going to a union elbow on the front plate to which is attached a loop-type superheater. A screwdown valve should be fitted as high as possible in the top corner of the backhead and the ⅛ in. pipe from this should go between the boiler and outer casing to a blower jet alongside the blast nozzle. The latter, by the way, should be arranged exactly as on a coal-fired engine to maintain good draught through the firebox. Methylated spirit needs plenty of air to ensure perfect combustion otherwise it gives off unpleasant fumes.

Steam and water gauges are not really necessary, as there will always be plenty of steam as long as the burners are going. Also if the boiler should run dry it suffers no harm. A clackbox or check valve can be screwed into the backhead and connected to a small hand pump in the tender. No other boiler feed is required, as the engine should run 30 minutes or more on one filling with a ten-coach train.

More 1¾ in. details

The superstructure of the engine can be made from thin sheet brass or even tin—it looks all the same when painted. The tender body should be made from thin sheet brass or copper, as a tin tank would soon go rusty. The axleboxes and dummy springs for the tender can be obtained "ready made" in the shape of the alloy die-castings used for clockwork and electrically-driven jobs sold commercially.

New readers who would like to have more information on details of construction should look up my instructions for building *Dot* (an L.M.S. 4-6-0 in 1¾ in. gauge) and similar engines.

INTRODUCING VIRGINIA

By William Collins

IN the issue for August 2, *Virginia* makes her début. *Virginia* is a 3½ in. gauge old-time American locomotive based on the 4-4-0 types made by Baldwin, Rogers, Hinckley, Grant and others towards the end of the nineteenth century.

She looks a winner and L.B.S.C., in designing her, had the beginner well in mind. That does not mean, of course, that she is a utility design—all the trimmings are laid on.

I think this little job is one of the most attractive ever to be described in MODEL ENGINEER, and I hope that an extra large number of readers will have a go. The 1957 M.E. Exhibition might have a distinctly Union Pacific flavour about it!

Anyway, remember the date—August 2—and make sure of your copy now.

Plastics

IN MODEL ENGINEERING—Part 2

EDGAR T. WESTBURY discusses the properties and uses of cellulose plastics

THE PLASTICS AT PRESENT commercially available may broadly be divided into three main groups, namely, Thermo-plastics, Thermo-setting plastics and Protein plastics. In the first two, as their names imply, heat plays an important part in their formative processes, but with an essential difference.

The first is capable of being softened or liquified by heat and re-solidified by cooling without any essential change in their chemical composition, but the second, although initially softened by heat, are also chemically changed, so that they harden and become incapable of re-conversion to the plastic state. The process may be considered as analagous to the changes which take place in the cooking of animal or vegetable substances, and is usually termed curing. Some materials in this group, however, can be made pliable after curing by moderate application of heat.

Protein plastics generally share some of the properties of thermo-plastics and may be processed by similar methods, though in some cases they can be rendered insoluble, and incapable of softening, by chemical means.

Types of plastics

Exact classification of all the plastic materials available is by no means easy, as some of them are sold under proprietary names or trade marks which give little or no clue to their origin. Some overlapping of the characteristics of materials in the three groups may take place, as minor alterations or additions to the chemical composition of certain plastics may affect their re-softening or curing properties.

With the rapid developments now taking place, new plastics are constantly being evolved, but the tables published recently represent the most useful materials generally available, so far as can be ascertained.

Apart from solid plastic materials, the various plastic adhesives and cements, also polyester and epoxy resins used for building up glass-fibre and similar fabricated structures, are of considerable interest to model engineers. The further articles in this series will deal with all types of plastics, under the various headings, giving particulars of their essential properties, methods of working, and wherever possible, sources of supply.

Introduction of cellulose

The first of the organic chemically-produced plastics to be used on a commercial scale was nitro-cellulose, the basic ingredient of which is cotton or similar vegetable fibre, converted by means of nitric acid to an amorphous form; all other plastics in this group are produced by variations of the chemical processes employed, including what are known as "mixed esters," in which more than one acid is employed.

In the original form, known as Parkesite, the nitro-cellulose was mixed with wood naphtha and castor oil to soften it for easier working and render it less brittle when solidified. Later it was found that alcohol-based solvents in conjunction with camphor were preferable as additives, and the product thus formed was known as Celluloid.

Nitro-cellulose was largely responsible for making possible the manufacture of flexible films to carry photographic emulsions, and thus played an important part in the development of motion pictures; it is still very extensively used for this purpose and it has also been used for combs, knife handles, accumulator cases and toys. In the latter capacity, a very large industry was built up in Japan during the period between the world wars, and this was facilitated by the availability of camphor, of which Japan had virtually a world monopoly.

Celluloid is mainly produced in sheet form, and is rarely seen in thick sections; it can be made either transparent or opaque, and in both cases may be coloured by dyes permeating its thickness, and not merely colouring the surface. Where extra strength or toughness is required it can be reinforced by linen or other fabric; conversely, it can be impregnated with fabrics or used as a surface finish. Examples of these applications are seen in celluloid belts or collars and in "patent leather" goods. Nitro-cellulose can be softened, or even completely dissolved, by volatile solvents such as amyl-acetate or acetone, in conjunction with which it is used in cements and adhesives, also paints, varnishes and lacquers.

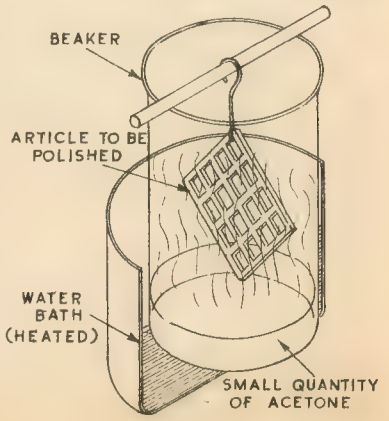
The practical applications of nitro-cellulose are, however, limited by one serious disadvantage—namely, inflammability. It ignites readily and burns with a fierce flame which is difficult to quench; many serious fires in cinema theatres and also in the home have been caused by it, so that special regulations have been imposed to ensure its safety in the former case, and its use has been prohibited for certain articles in domestic or personal application in many countries.

As a result, the search for a material having similar virtues, but partially or completely free from fire risk, has produced a number of modified cellulose products, the most important of which is cellulose acetate, in which acetic acid is used instead of nitric acid to produce the chemical reaction.

Initial difficulties

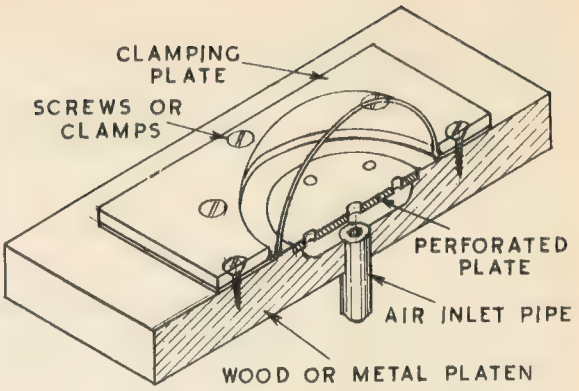
At first the replacement of nitro-cellulose with its non-inflammable counterpart was not as easy as it appeared, for the early product could not be made economically in a quality

Vapour polishing small articles in cellulose acetate



Plastics

IN MODEL ENGINEERING . . .



Forming a hemispherical dome by blowing with compressed air

to equal that of celluloid. It tended to be less transparent and to become discoloured with age, also to lose its flexibility. Stability in all respects was, however, largely a matter of close control of chemical processes, and the modern forms of the product, including its variants such as butyrate and ethyl-cellulose, are largely free from the above disadvantages.

An enormous advance in the commercial development of cellulose acetate was due to the discovery that it could be extruded through small jets, comparable to the spinnarets of the spider or silkworm, to form fine, tough fibres which could be woven into fabrics. This resulted in the birth of the artificial silk industry.

While it would not be correct to describe cellulose acetate as *absolutely* non-inflammable, since any substance basically derived from the element carbon is capable of being consumed by intense heat, it cannot be ignited by a transient flame or spark and it will not continue to burn unless a flame from another source is played on it continuously. To all intents and purposes, therefore it may be regarded as completely immune from fire risk.

Good insulator

It is an excellent electrical insulator, but it is not recommended for this purpose in cases where damp or moisture is encountered as it has only a limited water resistance, and may absorb water to a slight extent. For the same reason, variations in water content, or the evaporation of processing solvents, may cause warping or brittleness of the material in certain cases.

Articles of cellulose acetate are non-toxic and can be sucked or chewed by children or animals with safety, though not with relish ! Its hardness, flexibility, colouring and other properties are influenced by slight changes in its composition and various grades are available to suit specific purposes; exact technical information on these details can be obtained from manufacturers.

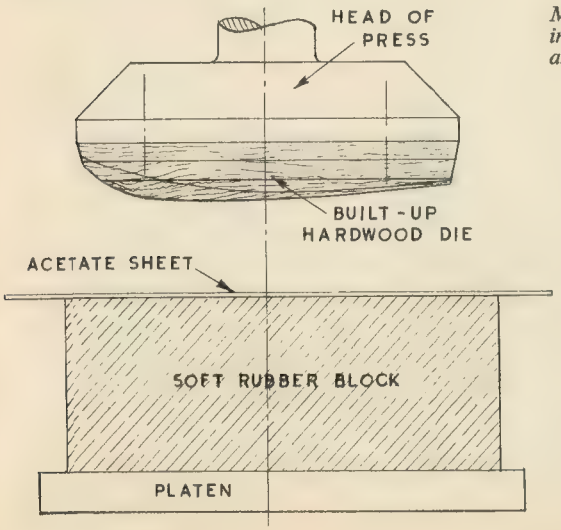
Machining and fabricating

Sheets, rods and tubes of cellulose nitrate or acetate can readily be cut, drilled or otherwise machined. Metal-working tools are generally applicable to these processes, though for efficiency in quantity manufacture, specialised tools, in respect of cutting angles, etc., are to be recommended, and some further information on this matter will be given later.

Owing to the low heat conductivity of this, and most other plastic materials, special care should be taken to avoid overheating, but the use of cutting oils or emulsions is not generally advisable. In drilling or tapping there is a tendency for the swarf to pack and weld itself to the tool, but this can be avoided by frequent backing-out. Maintenance of sharp edges in all cutting tools is essential.

Fabrication of these materials, if permanent, is most conveniently carried out by cementing and, since the special cements used have solvent properties, the action is practically equivalent to welding; the contact surfaces are locally reduced to the formative plastic state, and afterwards solidified by the evaporation of the solvent. This does not, of course, apply when cellulose plastics are joined to other materials, in which case general-purpose adhesives will give reasonably satisfactory results, but such joints are weaker than when both parts are of the same material and mechanical fixings, such as screws, are to be preferred.

Glacial acetic acid may be used as a cement for non-inflammable cine films and similar thin sheets of



Method of press forming with a single die and a rubber block

Manufacturers of cellulose plastics

NITRO-CELLULOSE

British Xylonite Co. Ltd., Larks Hall Road, London, E.4.

CELLULOSE ACETATE

Erinoid Ltd., Lightpill Mills, Stroud, Glos.

BX Plastics Ltd., Higham Station Avenue, Chingford, London, E.4. (" Bexoid ").

British Celanese Ltd., Celanese House, Hanover Square, London, W.1. (" Cellastine ").

Utilex Ltd., Kingston-on-Thames, Surrey.

RETAIL SUPPLIERS

Plastic Services Ltd., 16, Gloucester Road, Brighton.

G. H. Bloore Ltd., 66, The Broadway, Mill Hill, London, N.W.7.

cellulose acetate, but for heavier sections the following solvent cements are recommended by the makers of Erinoid plastics: (a) 7 parts acetone, 3 parts ethyl lactate; (b) 4 parts acetone, 3 parts ethyl lactate, 3 parts ethyl acetate.

If the edges of the parts are not an exact fit, a viscous cement capable of filling gaps may be made from: 1 part cellulose acetate scrap, 7 parts acetone, 2 parts ethyl lactate.

Finishing

Cellulose plastic sheets, rods and tubes are normally produced with a high surface finish and wherever possible this should be preserved, as it is difficult to polish out scratches or abrasions which may be produced in machining or handling. Cut edges may be filed, scraped and rubbed down with successively finer grades of abrasive paper, finishing with a polishing medium containing rouge or tripoli. Machine buffing is practicable, but calls for great care to avoid overheating as the material does not readily conduct away the heat.

Lacquers, applied either by spraying or dipping, may be used to produce a high surface gloss and they may be pigmented to give selective local colouring. Another method of improving surface finish is by dipping briefly in a solvent mixture, such as (a) above, and allowing it to dry off. Vapour polishing, by suspending the article over heated acetone for a few seconds, is also satisfactory and easier to control than dipping.

Other methods of surface decoration include impressing by means of heated dies, embossing of thin sheets by similar means, or applying gold leaf or super-thin metal foil by hot stamping. Metallisation by spraying or electrolytic methods, and inlaying with either metals or coloured plastics can also be employed to produce effective ornamentation.

Cellulose plastics can readily be bent and formed to simple and compound curves by heating to the point where it becomes pliable but not too soft. In industrial manufacture, radiant heating, with suitable temperature control, is favoured, but for processes in the small workshop, immersion in hot water will be found satisfactory, and most grades of material will soften at temperatures below boiling point. For simple curves, no special tools are necessary, but to ensure accurate and uniform bends a shaped former, over which the sheet can be smoothed down with a pad or roller and held in position till cold is desirable.

Compound curves are a little more difficult to deal with and it is often found advisable to make a simple die in wood, metal or plaster to produce the internal contour required. A two-part die may be necessary for very deep or intricate work, but shallow work can be formed with a single die in conjunction with a soft rubber pad, sufficiently resilient to compress into close contact with the entire surface. Puckering in deep-formed contours can be prevented by clamping the edges of the sheet in a frame so that it is stretched while being pressed.

Bulbous forms, such as observation domes for model gunboats or aircraft, can be produced by "blowing" the softened sheet material. A clamping plate having the required edge contour is used to hold the sheet down on a flat board or platen having one or more inlets, to which air is admitted at low or moderate pressure.

Heating in situ

It is best to use multiple inlets to distribute the pressure, and thus avoid risk of distortion by its concentration at one spot. An inversion of this method consists of using vacuum to draw the sheet either into a hollow die, or into contact with a raised form. All heat-forming processes must be promptly carried out and heating *in situ* is recommended.

The vacuum forming process offers a very simple and inexpensive method of producing intricate shapes in low relief from thin sheet, and is quite within the scope of the small workshop. To produce the required vacuum, a power-driven rotary or reciprocating vacuum pump is most efficient, but small jobs can be carried out with a laboratory air pump.

The industrial type of vacuum forming equipment illustrated here is capable of dealing with 24 in. × 24 in. cellulose acetate sheets up to 0.040 thickness. It incorporates a vacuum box, 3, having a perforated platform on which the relief mould, made of metal, wood, plaster or other suitable material is laid. Fixing of the mould is unnecessary unless exact registration with the outer edge of the sheet is required. The acetate sheet, which may be supplied either in roll or in the form of separate sheets, is laid over the box and held in place with the clamping frame, 4, secured by the toggle clamp, 6.

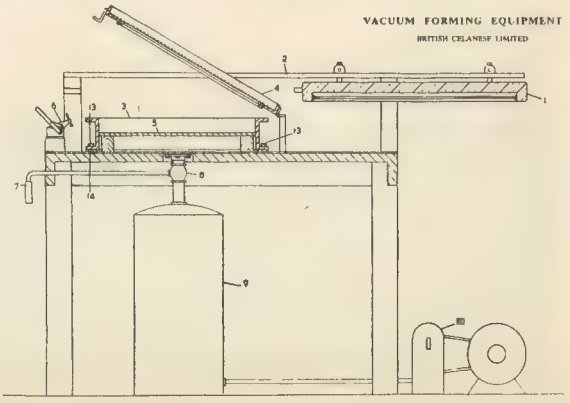
A radiant heater, 1, of the blanket type is brought into position over the frame and held there until the sheet becomes limp—not more than a few seconds in most cases. The heater is then withdrawn and simultaneously the control lever, 7, is operated to open the valve, 8. This brings the box into the communication with the vacuum tank, 9, so that the softened sheet is rapidly sucked down into close contact with the mould, the pattern of which is thus impressed in it so as to reproduce all its contours in detail. After the sheet has cooled it can be removed and the cycle repeated.

For small work, acetate sheets from 0.010 in. to 0.020 in. will be found most suitable, the thinner sheets being obviously best for fine detail work. The finished product may be reinforced if necessary by filling with plaster or similar material and the outer surface may be metallised or finished in any other desired manner. It is thus possible to use the method for the reproduction of badges, name-plates and medallions, except in cases where precise accuracy is necessary.

The plant illustrated employs a rotary exhauster capable of displacing 20 cu. ft. of air per min. and reducing the air pressure in the tank to not more than 0.01 in. of mercury. As the demand on the pump is intermittent, however, one pump of this size is capable of operating six 2 ft. by 2 ft. vacuum boxes.

Suitable rotary pumps are made by Messrs. W. Edwards and Co. (London) Ltd., Manor Royal, Crawley, and The Pulsometer Engineering Co. Ltd., Nine Elms Works, Reading. Blanket heaters, to produce a wire temperature of 425 deg. Cent., are produced by Hedin Ltd., Commerce (Trading) Estate, South Woodford, London.

● *To be continued*



1. *Blanket type heater*; 2. *heater runners*; 3. *vacuum box*; 4. *clamping frame*; 5. *adjustable platform (perforated)*; 6. *frame clamp*; 7. *control lever*; 8. *quick-action valve*; 9. *vacuum tank*; 10. *vacuum pump*; 13. *clamping bars*; 14. *sponge rubber gasket*

MAKING and FITTING SPECIAL CAPSCREWS

Conclusion of the two-part feature by DUPLEX

IN LAST WEEK'S article a description was given of machining hexagon-headed combination screws. Now the various methods of fitting these are dealt with.

Three different ways of fitting the special screws are shown in Fig. 7. Method *A* gives a good appearance when applied to some engine and machine tool components, although in these instances it may be considered preferable to chamfer the upper edge of the collar below the screwhead to suggest a bevelled washer.

Where the second and third methods of fitting are adopted, namely those illustrated at *B* and *C*, the clearance hole for the screw shank is counterbored either to allow only the collar or the whole screwhead to lie flush with the work surface. In the latter case a space is left in which chips can accumulate, but this also applies to an Allen capscrew with a recessed head.

As previously described the collar formed on the screwhead is made only slightly larger in diameter than the box spanner; this is done for the sake of compactness and also to give a neat appearance when the screwheads are in evidence.

This arrangement entails employing odd-sized counterbores instead of the fractional-inch sizes suitable for re-

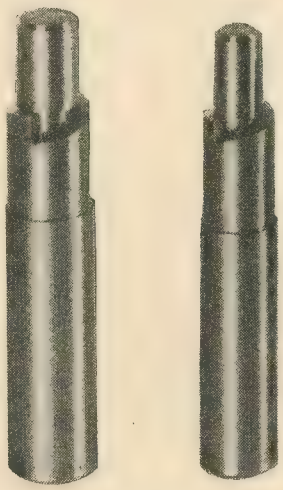


Fig. 8: Two sizes of counterbores with ¼ in. and 5/16 in. removable pilots

cessing the heads of standard capscrews. But the necessary tools are quite easily made in the workshop from silver-steel rod, which is hardened and then tempered to a straw colour at the tool's cutting edges.

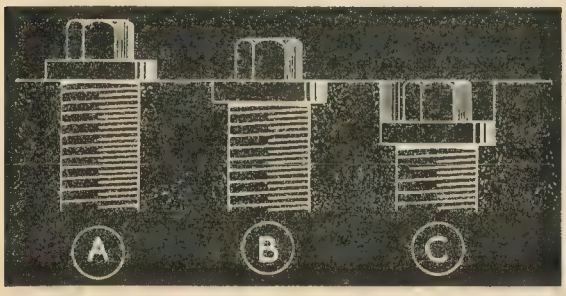
The rod is gripped in the self-centring chuck and supported by the tailstock centre to enable the shank and cutting portions of the tool to be turned concentrically and to the finished diameter. To give clearance behind the cutting edges the diameter of the tool in this situation is reduced by a few thousandths of an inch, and the cutter is afterwards drilled axially at the same setting to take the guide peg or pilot.

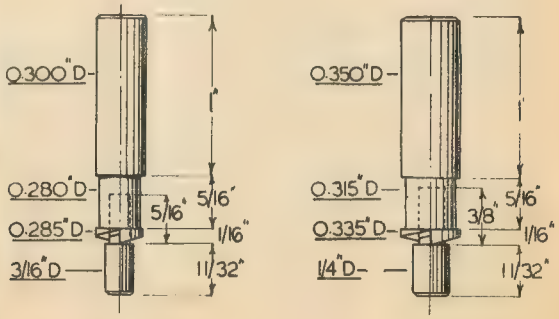
When forming the two cutting lips, a cut can be made with a fine hacksaw diametrically across the end face of the tool and to the full depth of the teeth. The lips are then formed roughly to shape by taking two further cuts to remove the bulk of the surplus metal, and the teeth are finally formed to shape with sharp cutting edges by the careful use of a fine file.

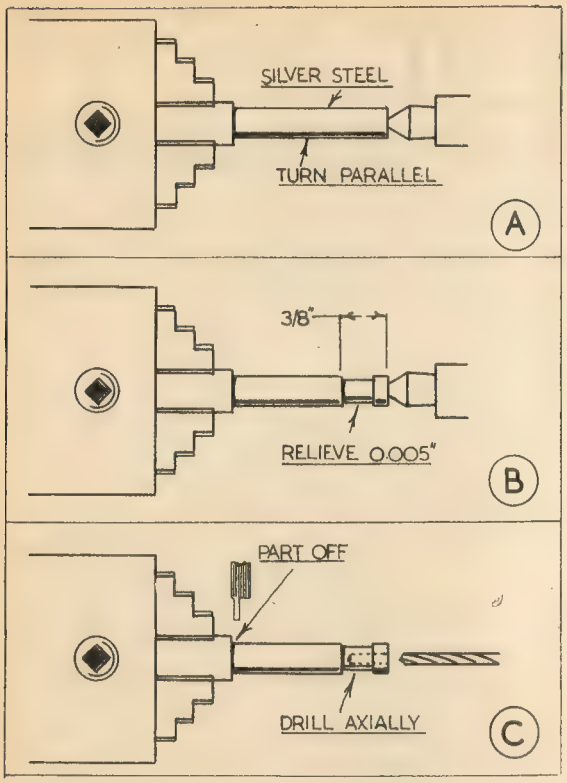
The pilot, which is best machined from silver-steel rod, has its two diameters turned at the same setting to ensure concentricity; one end is made a light press fit in the end of the cutter and the other should be a running fit in a hole drilled to the clearing size of the screw.

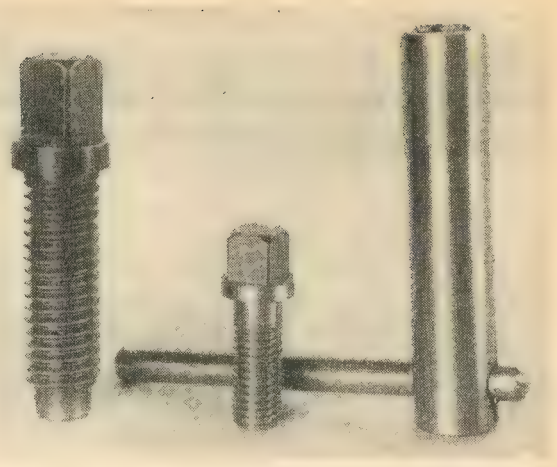
In addition to hardening and tempering the cutter it is advisable to treat the pilot in the same way in order to reduce wear. When used on steel the cutter should be run at low speed and kept well lubricated otherwise chatter is liable to develop; moreover, to preserve the cutting edges, the tool should be kept cutting freely and not allowed merely to rub

Below, Fig. 7: Three different ways of fitting the combination screws
Right, Fig. 9: A counterbore for fitting the 2 B.A. screws (left); a ¼ B.S.F. counterbore (right)









Above, Fig. 11: *Two sizes of square-headed clamping screws and a useful box key*

Left, Fig. 10: *The series of operations for machining counterbores*

Bottom left, Fig. 12: *Indexing jig for machining square-headed screws*

Bottom right, Fig. 13: *Dimensions of the jig for indexing ¼ in. diameter screws*

against the work. The time occupied in making a set of these counterbores will be well spent, and the scope of the tools will be increased if the pilots are made removable and interchangeable.

The square-headed screws illustrated in Fig. 11 are examples of those made in the workshop for use as clamping screws when fitted to toolholders. Screws of this pattern, besides being of neat appearance, have the advantage that the collar below the head serves to locate the key spanner so that it does not slip over the head of the screw.

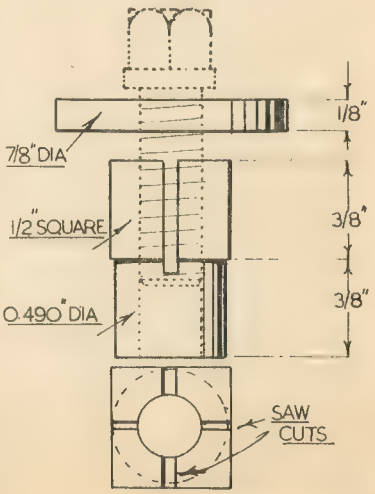
The method employed for machining these screws is essentially similar to that described for making hexagon-headed screws, but a different type of indexing holder or jig is required for machining the head in the milling machine.

As shown in Fig. 12 the holder is made from square mild-steel rod of a diameter across the flats some ¼ in. greater that the nominal size of the screw shank. The easiest way, perhaps, of making a jig of this kind is to centre the rod in the four-jaw lathe chuck or in a special holder carried in the self-centring chuck and then to drill and tap the work axially.

The rod is next clamped in the lathe toolpost so that it can be slit in two planes at right angles to one another by means of a circular saw mounted on an arbor supported by the tailstock centre. To form the cylindrical skirt that affords clearance when a screw is clamped by the machine vice in the jig, the holder is cut off to length and then mounted on a threaded stub mandrel gripped in the chuck.

Screws that are in constant use, such as those serving as clamping screws in toolholders, are best case hardened to reduce wear on both the spanner flats and the tip of the screw taking the clamping pressure. In addition, the appearance will be enhanced and the screw threads rendered less brittle if the screws are afterwards tempered to a dark-straw colour.

For operating these clamping screws a robust type of box-key with a fixed handle, like that illustrated in Fig. 11, will be found superior to the ordinary tubular box spanner. ■



READERS' QUERIES

★ ★ ★

This free advice service is open to all readers. Queries must be of a practical nature on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling, cannot be given: stamped addressed envelope with each query. Mark envelope clearly "Query," Model Engineer, 19-20, Noel Street, London, W.1.

Dynamo suppressor

Q I have a d.c. dynamo supplying current for house lighting and as this causes interference with the radio—a battery set—by humming, can I apply some kind of suppression? The dynamo is 110 V, d.c. and normally gives 3 A (though it is a big machine and capable of giving about 10 A). It is a two-pole shunt machine running at about 900 r.p.m. The armature is about 4 in. dia. by 6 in. long and the commutator has about 40 segments. It charges a 110 V. Nife battery, but the cells are not big enough to supply the light for long without the dynamo running. —B.M., Wigan, Lancs.

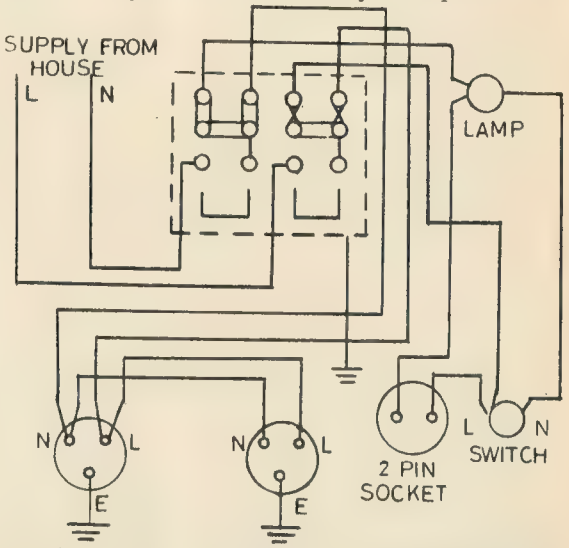
A Suppression may be obtained by connecting two condensers of between ½ and 1 mfd. across the dynamo brushes. Two condensers are used, coupled in series. The mid-point connection is connected to earth, the remaining ends being connected to each respective brush of the dynamo. As the characteristics of dynamos will vary considerably there will have to be a certain amount of trial and error by increasing or decreasing the condenser capacity. As the voltage is only 100 ordinary paper condensers may be used.

Garden-shed installation

Q I have built a garden shed and want to electrify it for lighting and machinery from the house. I wish to wire the following: a central lamp in the ceiling, one 3-point plug and socket for one ¼ h.p. capacitor-type motor, one 3-point plug and socket for a second motor, one 3-point plug and socket for a standard or miniature soldering iron and one 2-point switch plug for a wander lamp. The two lamps will be about 60 watts each. Only two points will be used, i.e., motor and lamp, etc. All the wiring will run to a 2 fuse 10 amp switch box, and will be concealed behind hardboard covering which lines the interior.—J.H.H., Grays, Essex.

A Any supply for the shed should be taken from the point of the supply entry to the building. At this position a 15 amp double pole switch fuse should be provided. The circuit, if it is to be laid above or underground should be carried out in a lead-covered cable, the size being 3/20 s.w.g. Where the cable leaves the house and is erected on the fence or underground, it should be protected by running the cable in a steel conduit, preferably galvanised. The cable and conduit must be efficiently earthed. At the shed a two-way splitter type of switch fuse should be provided, the neutral side being solid links and not fuses.

Although not normally allowed under institution rules the plugs and the lamp and plug may be connected as a parallel circuit. The lamp and the two pin socket should be connected to one fuse way, the other fuse way taking care of the two three-way sockets. Lead-covered cable is suitable for the shed wiring and the size may be 3/32 s.w.g. Great care should be taken of the earthing, and a wire not less than 14 s.w.g. in section should be used. Special bonding clamps are available for the earthing of conduits and lead covered cables. The capacity of the three pin sockets may be 5 amp. In connecting the circuits observe the polarity as shown in the sketch.



Circuit diagram for laying on electricity to a workshop. See "Garden shed installation"

Transparent lacquer

Q Can you advise me how to use transparent golden lacquer—the type used on microscopes and other instruments made of brass—and where it can be bought, ready mixed?—J.S.P., Stoke-on-Trent.

A Most instrument lacquers are applied either by brushing or spraying, the metal parts being first heated to a temperature rather hotter than can be borne by the hand, but there are also cold lacquers, mostly having a cellulose base, which may be found easier to apply. These lacquers can be obtained from most firms dealing with accessories for the clock and instrument trade, such as E. Gray of Clerkenwell Road, London, E.C.1.

Speed control

Q I intend electrifying a sewing machine, and understand that the chief difficulty is the speed control. I shall be using a fractional a.c. motor, probably of the induction type, and require information on the form of variable resistance used. I believe it should not be of the stud type but should embody some sort of carbon resistance.—R.S.T., Belfast.

A The controlling resistances for sewing machine motors are usually of the carbon pile type, consisting of a large number of small carbon discs pressed together by a spring, the tension of which can be varied by means of a foot pedal. This type of resistance is one of the simplest and most satisfactory for this particular class of work, but a wire-wound resistance could be used with a sliding contact or with tappings connected to a selector switch. This, however, would not be quite so convenient for operating by means of a foot pedal. The total resistance of the rheostat, in either case, should be fairly high, probably in the region of 800 to 1,000 ohms.

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

THE TURNING TRICYCLE

SIR,—A combination of speed and centrifugal force is the answer. A tricycle, like a car, cannot even with the help of the driver counteract centrifugal force while changing direction.

An aeroplane can do so by being banked, and so can a bicycle. To test this, Vulcan should drive his car round two similar corners at a fair speed, one banked and the other not banked. He will notice a considerable difference.

Vulcan does not mention his *rate* of turn or change of direction. If he had been riding comparatively slowly and suddenly turned the front wheel at right angles to the line of the frame, he may well have turned the machine over in the direction of his original travel, again due to centrifugal force.

Cheshire. R. M. DIXON.

U.S. CAR FERRIES

SIR,—In the issue of May 31 W. K. Kidston asked for some help on old-type car ferries. Since I am interested in these old ships, I might be able to assist him.

I do not know of any plans for a railroad car ferry, but there is a set of plans for a side-wheel pleasure steamer called *Mt. Washington*. This ship had a beam engine of the type Mr. Kidston wants. She was built in 1872 and was destroyed by fire in 1939. The plans are to $\frac{1}{4}$ in. scale. James Bliss, of Boston, has them in stock for about six dollars.

If Mr. Kidston would like to get in touch with me, I would be glad to help him.

1147 Park Blvd. E. G. ALLEN.
Massapequa Park,
New York, U.S.A.

ANYONE KNOW IT ?

SIR,—I am enclosing some pictures of my lathe. I picked it up some years ago in a junk shop. I was so struck by the exquisite workmanship and the reasonable price (as things go) that I bought it. I am not sure whether it should not be described as a " watchmaker's turns " or not.

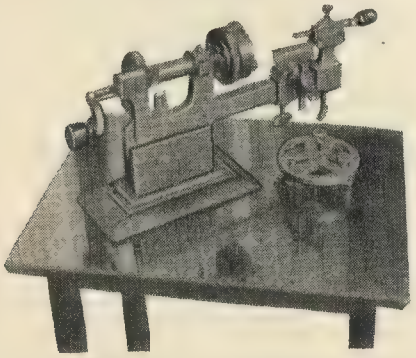
Practically the whole construction is of bronze. Centre height is approximately $2\frac{7}{16}$ in., between centres 5 in. The name Deposé is stamped on one of the faceplate jaws, also the letters AN and number 4796. As you can see, the lathe is hand operated through skewgears and can be used with compound rest or T-rest. The base is hardwood.

I would be very pleased if any reader could give me some information about this lathe as in 40 years experience I never saw anything like it.

I was interested in your articles " Man Moves Mountains," as excavators have been my livelihood for 30 years. I have worked with all sizes and makes from $\frac{3}{8}$ cu. yd. machines to $4\frac{1}{2}$ cu. yd. machines weighing 170 tons.

I have been a reader of MODEL ENGINEER for over 40 years.

Dun Laoire, W. L. WATTS.
Eire.



Can anyone identify this lathe ? It was purchased from a junk shop by W. L. Watts, of Eire. See " Anyone know it ?"

RAISED COAL PLATES

SIR,—With reference to my recent letter about the tenders supplied to the Dean Singles (Postbag, May 17), the old notes I referred to were supplied by a G.W.R. draughtsman about 1920, and stated:

" Class 3031 engines, coal-railed tenders 3,000 gals., numbered in 1300s and 1400s. Engines retained these tenders until withdrawn. Withdrawn engines' tenders transferred to other classes."

I was not exactly certain if this was so, myself, as I had only seen one or two of the engines towards the end of their careers, and did not give particular notice to the tenders and I had never seen a photograph of any of them with raised coal plate tenders.

I took the information to be correct, but as I say I was not fully certain and at the same time I was aware that since tenders with raised coal plates began to appear, as Mr. Maskelyne says, at end of 1903 and some of the Singles were in service as late as 1914-15. At least some of them, one would think, would have had raised coal plates.

I am very grateful to Mr. Maskelyne and Mr. Balleny for clearing the matter up regarding these old notes and to Mr. Maskelyne for his kindness in supplying the photograph of No. 3006. This is the first picture I have ever seen of one of these engines with modified tender. It may possibly have been that the notes referred to the tank capacity of the tenders only and perhaps meant that none of the engines were ever provided with tenders of more than 3,000 gals. capacity during their working life.

Birmingham. A. J. RICHARDS.

NO BUTTONHOLE !

SIR,—I have been admiring Mr. Maskelyne's line drawing of the small G.W. old-timer No. 34 and I notice that the buttonhole behind the funnel has been pinched from the drawing—a dirty trick ! The photograph seems to show the smoke spout a shade taller I fancy.

These drawings are absolute masterpieces. It is a lot easier to find fault than do a job, but how would I get on if I dropped the lubricator and Mr. Maskelyne was the judge !

Cardiff. G.W.R. FAN.

TRAVELLING P.O.'s

SIR,—An American correspondent has sent me the photograph showing a class G.E.32 gasoline-electric passenger railcar, No. 6044, of the Baltimore and Ohio R.R.Co. The B. and O. has several of these vehicles in service, the one shown being photographed at Zanesville, Ohio on 30 July 1951.

The United States Post Office has also several of these cars in service which are used as travelling post offices and they operate on various U.S. railroads for the conveyance and sorting of mail en route.

Tyseley, Birmingham 11. A. J. RICHARDS.

Above: A gasoline-electric railcar on the Baltimore and Ohio Railroad. See "Travelling P.O.s"

AUTOMATIC FEEDS

SIR,—It is some time since Mr. Oram's letter was published (MODEL ENGINEER, April 26) but it did not go unnoticed.

Surely the basis of his requirements are to be found in the reversing independent self-act feeding gearbox which is fitted to my ML7—some details of which appeared in the article "Towards the Ideal Lathe?" (MODEL ENGINEER, 6 January 1955). The forward, reverse and neutral—leadscrew free to be turned—are controlled by a hand lever just under the headstock, and, if desired, it should not be very difficult to arrange some sort of "load and fire" spring triggering arrangement, so that the saddle reversed it at the end of a cut.

A full description of this particular gearbox has not been given as it is not constructed from readily obtainable gears and materials.

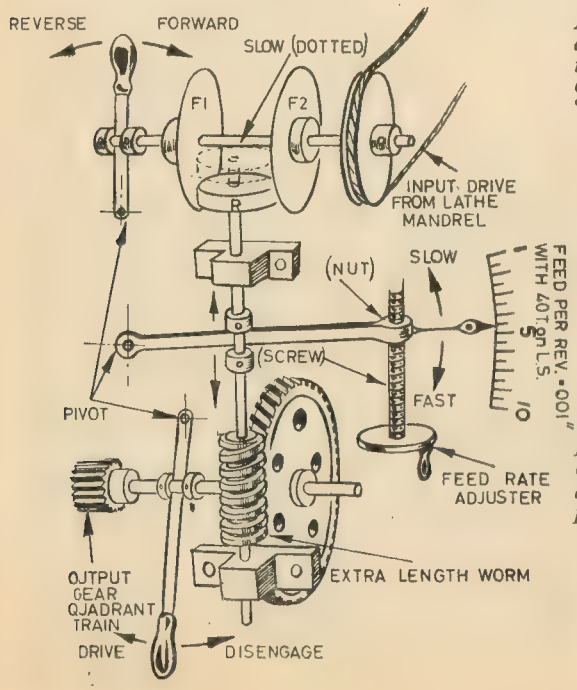
For the benefit of those who may like to have a go at constructing a "luxury" independent feedbox, I have sketched a plan showing the outline of an arrangement containing all that could be desired—including an infinitely variable feed with a graduated indicator. The various levers and controls could, of course, be bell cranked into any desired centralised position.

The discs, F_1 and F_2 by the way, do not have to revolve in opposite directions; according to which one drives the friction wheel R, so it will go clockwise or anti-clockwise.

To obtain the best results from such an arrangement the input and vertical shafts should run in ball races and a ball thrust should be provided to absorb the pressure from the friction discs. One-eighth balls are easily and cheaply bought from any cycle dealer and, for light work of this type, need not run in hardened housings.

The final reduction worm and wheel are really diagrammatic; I should favour an internally splined bevel and spur reductions; a worm would need to be of an efficient two or three start type. Before constructing a mechanism of this type it is often very helpful to make a model with Meccano—this will always give a clear idea as to the required dispositions of the spindles and gears etc.

St. Leonards-on-Sea. M. CLEEVE.



Left: This is Martin Cleeve's plan for a "luxury" independent feedbox

RAISING THE "ALEXANDRA"

SIR,—The article on floating bridges (MODEL ENGINEER June 7) was of considerable interest to my father, who has often told me of the sinking of the *Alexandra* in Portsmouth Dockyard during the 1914-18 war. My father served 46 years in the dockyard as leading caisson man.

This is how my father describes the sinking of the floating bridge:

"During the World War I the *Alexandra* was put into No. 3 basin blackout, one night she sunk in 40 ft. of water. It is said that some boys were seen on board during the afternoon and that they played about with some of the flooding valves.

"As a caisson man I let the diving boat and crew into the basin from the sea and worked was started to lift her. Two divers, G. Brown and Charles Duffin, went down and we succeeded in putting her into our big lock.

"I pumped the water out of the lock and repairs were carried out and the *Alexandra* was refloated and put back into No. 3 basin."

Portsmouth. ROBERT G. DAVIS.

POSTBAG . . . .

LARGEST EVER ?

SIR,—With regard to Vulcan's remarks about the hydrogen cooled stator for Meaford B power station, the photograph is of the stator for the generator and is designed for a continuous load of 60,000 kw. at 0.8 power factor generated at 11,800 v. and then boosted to 132,000 v. for transmission.

The steam pressure of 1,500 p.s.i. at a temperature of 1,050 deg. F. are those designed for the steam conditions entering the turbine stop valve used for driving the generator and a steam flow of about 475,000 lb./hr. is required to maintain the above generator load.

The load was claimed as the largest ever to leave the Rugby works of B.T.H. but it is debatable whether some of the electrical plant despatched at times from other manufacturers is not comparable. To my knowledge the 132 kv./275 kv. step transformers recently commissioned at Drakelow generating station, also delivered by road, were of a somewhat similar weight.

Finally the stator is for the second machine being installed at Meaford, the first having now been on load for some weeks.

Maidenhead, Berks. D. G. WEBSTER.

BUILT 25 YEARS AGO

I enclose a snap of a steam engine and boiler I made about 25 years ago. It was built up from scrap and all the turning was done on a wood-turning lathe.

The engine is $\frac{13}{16}$ in. bore × $1\frac{1}{4}$ in. stroke. I displayed it at the Canadian National Exhibition in 1935. It was the first year a hobby show was put on there. I had not made the boiler then, but I built it shortly afterwards.

Perhaps the following method, which I use to true up stock in the chuck, may be appeal to some of your readers.

I use a rod, set at 90 deg. in a flat piece of metal that is laid across the ways of the lathe. The rod is pushed against the stock. Turning the lathe by hand will show the amount that the stock is out of centre.

Hazel Dell, Saskatchewan, Canada. ARTHUR WILSON.

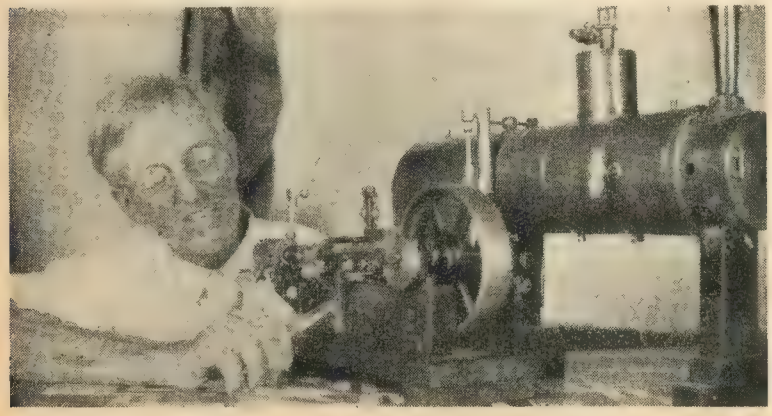
PARDON MY INTERRUPTING . . .

SIR,—L.B.S.C. is in error (M.E., June 28) when he states, " There is an old saying . . . ' a little knowledge is a dangerous thing '."

He is presumably misquoting from Pope's *Essay on Criticism* which reads, " A little learning is a dangerous thing."

Hall Green, Birmingham, 28. H. CHASE.

Arthur Wilson with his steam engine which showed at the 1935 *Canadian National Exhibition. See " Built 25 years ago "*



The steam-operated Dartmouth ferry

THE DART FERRY

SIR,—I was very interested in the recent article describing the Portsmouth-Gosport floating bridge.

I enclose a picture of a ferry on the River Dart at Dartmouth which, I think, is unique in that while the vessel is guided by wire ropes (as the Southampton-Woolston ferry) propulsion is effected by non-feathering paddle wheels.

The picture was taken in 1935 and I do not know whether this ferry is still in operation. But perhaps a West Country reader could provide some information on this point ?

It was operated by Messrs. Philips and Son of Dartmouth, and, to the best of my recollection, the paddles were gear-driven by a small horizontal steam engine, the boiler being situated on one side and the engine on the other side of the pontoon.

Harlesden, London, N.W.10. RALPH H. DORMER.

LOCOS I HAVE KNOWN

SIR,—Regarding " Locomotives I have known," No. 9, S.E. and C.R. 2-4-0 engine No. 512; as a schoolboy during the period 1903-07, I was well acquainted with two of this class of locomotives—Nos. 513 and 515. One or the other used to work an evening train regularly from Victoria to Crystal Palace (high-level), and I frequently travelled behind it between Nunhead and Honor Oak.

They were certainly kept in excellent condition and the unusual design was always a matter of interest to me. They appeared to give a bit of trouble when leaving Lordship Lane Station and slipped rather badly, probably due to the up-gradient and their rather large driving wheels.

Normally the service on this line was worked by 0-4-4 tank engines which appeared much better suited to cope with the frequent stops and the steep gradients between Nunhead and Crystal Palace.

Carlisle. J. F. PERRIN.

★ ★ ★ CLUB NEWS ★ ★ ★

Edited by THE CLUBMAN

THIS is the time of year when the model engineers are visibly alive and kicking in their own communities. Needless to say, they are very much alive all the year round—and every hour which they devote to modelling and to modelling problems is an hour spent in the service of craftmanship. But the public usually has to wait until the summer for the work of the clubs to be properly seen and appreciated. Nothing wins them more friends than their model locomotives and railways, a perpetual enchantment to people of all ages.

The club with a portable track is sure to have a busy summer. Here, for instance, are some of the events which **Malden and District S.M.E.** has on its list:

August 6, Sutton Common Allotments Society Annual Show; August 6, Twickenham Faire; August 25, Twickenham Faire and "Lessa" Sports; August 31, Twickenham Faire; September 1, Lines Bros. Sports, Merton.

These are bookings which have been amended. The full list shows a steady march through the summer, with sometimes more than one engagement on the say day.

I am, therefore, glad to know that some new volunteers have come forward to relieve the veteran trackmen, who will now be able to have a few Saturday afternoons off this summer! Too often in our clubs the old faithfuls, because of their experience and cheerful willingness, are allowed to bear the brunt of a season's programme largely because the younger or newer members are shy of stepping forward.

ENTHUSIASM ABROAD

For several years A. H. Harlow was secretary of the **Bournville Model Yacht and Power Boat Club.** Under his stewardship the club thrived in efficiency and in its friendships with other organisations.

Today, Mr. Harlow is living in South Africa. Taking his enthusiasm with him, he has founded a new club—the **Port Elizabeth Marine Model Club,** which holds a lakeside meeting every Sunday morning and an open club meeting once a month at the Technical College.

So far there are about 40 members, able to muster a fair number of small i.c. engined boats (including 5 c.c. and 10 c.c. hydroplanes) and three very good radio-controlled models. In the pioneering stages they are using commercially-made engines—but it will not be long before they are building their own.

Their immediate plans, when I heard from Port Elizabeth, included a regatta featuring radio-control, and a stand and demonstration tank at a hobbies carnival. This is the way for a club to begin. I know that all readers of this page, whether or not they have the pleasure of knowing Mr. Harlow, will wish the Port Elizabeth M.M.C. a prosperous future. Its secretary is A. Rutherford, 30, Fifth Avenue, Newton Park, Port Elizabeth.

M.E. DIARY

August 5.—M.P.B.A. National Speed, St. Albans, 12 noon. (Aug. 5 and 6).

August 14.—Topsham M.E.S., Exhibition of Working Models, Church Institute, Ferry Road, Topsham. (Aug. 14-18).

August 18.—Traction Engine Derby, Pickering, Yorks, 3 p.m. (Exhibition from 1.40 p.m.).

August 27.—Exeter and District M.E.S. Exhibition, Royal Albert Memorial Museum, Queen Street, Exeter. (Aug. 27-Sept. 8).

August 22.—*Model Engineer* Exhibition, New Horticultural Hall. (Aug. 22-Sept. 1).

In Yorkshire on August 18 Old Glory will accept the final challenge, on equal terms, from four Fordson Majors in a duel to the death.

This epic struggle forms the climax of the fourth Traction Engine Derby organised by Pickering Sports Committee. The programme opens with a parade of engines, and features competitions for the best-kept engine, veteran car, and veteran motorcycle, slow races for veteran motor cars and motorcycles, an obstacle race for veteran motorcycles, and musical chairs for veteran cars.

There is a slow race for traction engines as well as the big race over a mile—the first Derby for engines of seven tons and over and the second for engines under seven tons.

Special rail facilities are being provided by British Railways and the official car park will accommodate two thousand cars on the field.

Those who wish to enter engines or cars should communicate with secretary F. Hamilton at Wold View, Pickering (Pickering 139) or with G. L. Lazenby, 2 Park Street, Pickering (149) before the closing date: July 23.

Topsham M.E.S. is offering a Visitors' Trophy to be won outright at its exhibition of working models in the Church Institute at Ferry Road, Topsham, from August 14 to 18.

Secretary S. Barwell of 14, Elm Grove Road, Topsham, will be glad to send entry forms and particulars. The closing date is August 14.

"It is hoped," Mr. Barwell writes, "that clubs from the districts surrounding Exeter will rally round, as we feel that by visiting other clubs' exhibitions and track days an effort is being made to further the cause of model engineering."

In fact, of course, the result is much more than an effort! I feel sure Topsham will be well supported by **Exeter and District M.E.S.,** even though the Exeter society has plenty to occupy it at the moment. The Exeter exhibition opens at the Royal Albert Memorial Museum in Queen Street on August 27.

MECHANICS

Most model engineers like to employ their skill about the house. They will find much to interest them in the August issue of *Mechanics,* the two-colour make-it-yourself magazine on sale tomorrow (price 1s. 3d.).

How to make a refrigerator in a cupboard, a pair of wrought iron gates, a garden roller and garden chair, a set of wall bookshelves and a silver music box—these are some of the inviting articles in an issue crammed with good reading.

Take the August *Mechanics* on holiday with you and put yourself in well with your wife. She'd love that music box, incidentally!

Model Engineer

Classified Advertisements together with remittance should be sent to Model Engineer, 19/20, Noel Street, London, W.1, by latest Thursday morning prior to date of publication. Advertisements will be accepted from recognised sources by telephone. GERRARD 8811. Ex. 4

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WORKSHOP EQUIPMENT

Buck & Ryan for Lathes and Workshop Accessories, drilling machines, grinders, electric tools, surface plates, etc.—310-312, Euston Road, London, N.W.1. Phone: Euston 4661.

Immediate Delivery from Stock. Myford "M.L.7" and "Super 7" lathes, Grayson, Super Adept lathes, bench planers, shapers, electric motors, small tools.—F. W. KUBACH, 12, Sylvan Road, London, S.E.19. LIV 3311/12.

Special Offer in makers' packs, new independent chucks with reversible jaws, key and backplate screws. "Crown" 4½", heavy duty, weight 8½ lb., bore 1⅝" × O/A, depth 2⅜", £4; "Crown" 6", medium duty, weight 9½ lb., bore 1⅝" × O/A depth 2½", £4; "Acorntools" 6", medium duty, weight 9½ lb., bore 1½" × O/A, depth 2½", £4; "Belco" 8", weight 32 lb., bore 2½" × O/A, depth 4", £7; "Belco" 10", weight 45 lb., bore 2½" × O/A, depth 4½", £9; "Belco" 14", weight 95 lb., bore 3½" × O/A, depth 4½", £12; "Belco" 16", weight 125 lb., bore 4" × O/A, depth 5½", £14. All carriage paid. Cash with order.—ACORN MACHINE TOOL CO. (1936) LTD., 610-614, High Road, Chiswick, W.4. Chiswick 3416.

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Three Tools in One. Wilson bench and machine vices, descriptive leaflets from your local tool stockists or direct from—W. H. COLT (ENGINEERS) LTD., 312, Grand Buildings, Trafalgar Square, London, W.C.2.

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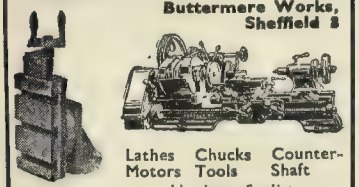

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Exchange. Grindturn Eng. Co. Lathe. 1⅝" centres for camera. Details to—HUGHES, 59, Scarborough Road, Norton, Malton, York.

Small Horizontal Pedestal Miller, swivelling table 5" × 24" back geared, £35. ¾ h.p. a.c. motor, 230-250 v., practically new, £7. Buyer collects, after 6 p.m.—MR. CLARKE, 5, Gartmoor Gdns., Southfields, London, S.W.19.

Sale. Drummond Lathe, 3½" B.G.S.C., 3-jaw, tailstock, chuck, full set change wheels. Also "Juliet," any trial.—W. J. BAGG, 6, Pavilion Gardens, Staines, Middx.

Exchange. New boxed N.S.F. 11" Vernier height gauge or powered V.H.F. feeder unit for super Adept/similar lathe.—FINDON, Court Royal Mansions, Brighton, 7.

For Sale. Poole bench miller, new, unused. With bench, adjustable lamp, new Startet switch, machine vice, div.-head, cutter, £30. New ⅝" cap. bench drill, universal table. With bench Startet switch, motor, adjustable lamp, £20. Submerge pump, 230 volt, ¼ h.p., £2 10s. 110 v., ¼ h.p. Flexdrive set, drive needs repair, £2 10s.—V. R. FRANKS, 67, Myddelton Square, London, E.C.1.

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For Sale. Wells Lathe (American) 5½" centre with thread chasing attachment and countershaft, £15. Vertical miller, complete, £40. Voumard precision bench lathe (Swiss) 3½" centre on stand, £55. All above in good order.—TAYLOR, 57, Church Green Road, Bletchley, Bucks.

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Victory Industries (Surrey) Ltd. require a skilled assistant for work on prototypes. Must have experience in model making. Tool makers also required. Good pay and prospects, pension scheme. Write—BARFAX WORKS, Worplesdon Road, Guildford, Surrey.

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Model Engineer

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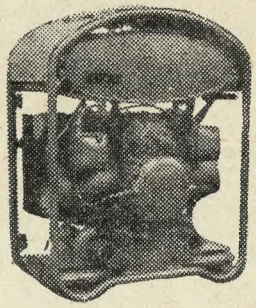

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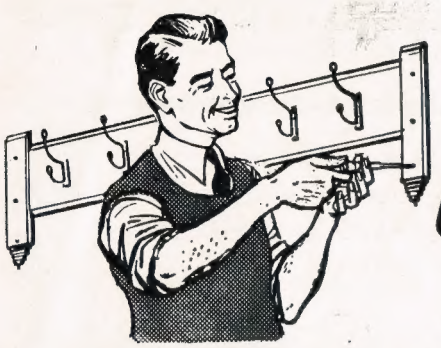

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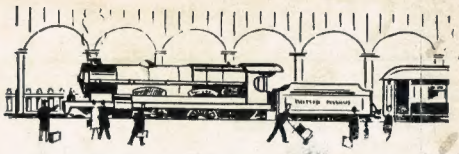

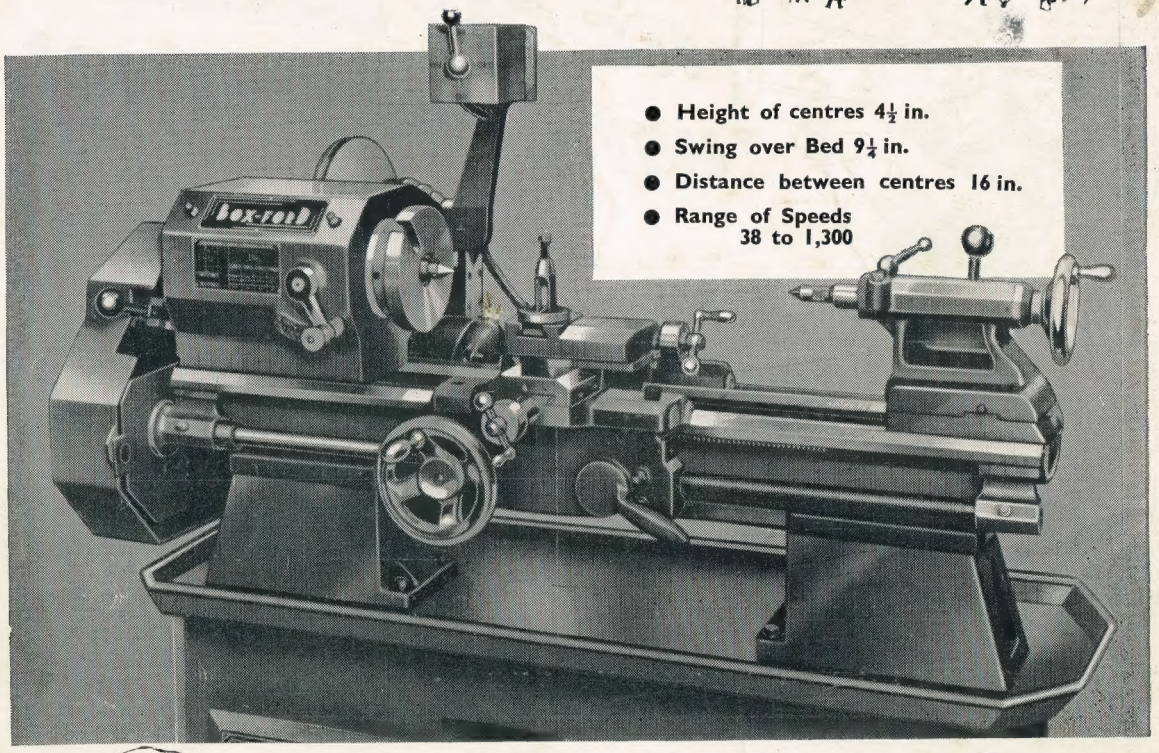

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